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POPULAR SCIENCE

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In This Issue—Hundreds of Fascinating Articles Tell the Latest News of Laboratory Discoveries, Scientific Triumphs, and Amazing New Inventions

Motorists Wise

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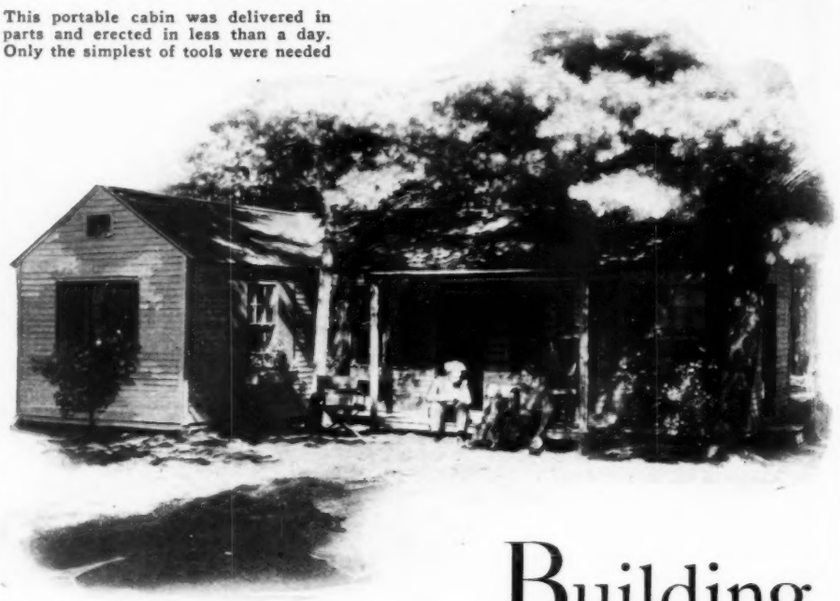


This portable cabin was delivered in parts and erected in less than a day. Only the simplest of tools were needed

Building Your Vacation Cabin

An inexpensive rustic cabin constructed of log siding

By R. M. BOLEN
Secretary, Popular Science Institute

IN NO branch of house building is there a wider choice of materials and methods than in the construction of summer camps and cottages. For this reason, the cost of your vacation cabin can be gaged to suit your pocketbook.

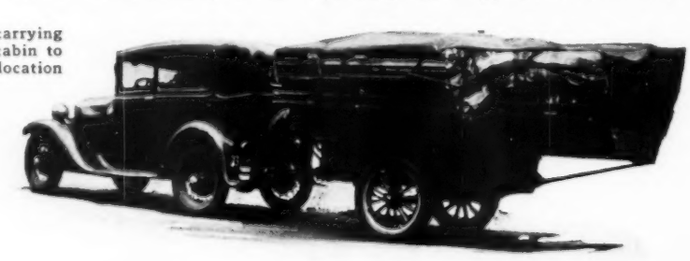
If you plan a rustic cabin in the woods where tall trees are plentiful, natural logs will offer the cheapest material. Two expert woodsmen can cut enough raw lumber for the average small cabin in a few weeks. The actual construction you can do yourself, a little at a time.

Of course, there are many choice spots where real logs are scarce and the cost of importing them prohibitive. But even the lack of logs need not prevent you from owning a log cabin. You can build it of imitation logs—boards cleverly rounded to look like natural pine logs stripped of their bark. Log siding, as this recently developed log finish is called, is easy to apply and inexpensive and its ship-lapped edges make it both sturdy and weatherproof.

Being available in several widths, log siding gives a realistic log effect. It can be used in its natural finish, which will weather to a soft gray, or it can be stained. Then, as an added touch, a coat of thick white paint mixed with fine sand can be applied to the recesses between the "logs" to give the appearance of chinking.

If you wish, you can reduce the cost of your vacation home further by using ordinary drop siding instead of log siding, while common boards lapped like siding will be the least expensive of all. Neither of these, of course, will have the pleasing rustic appearance of real or imi-

A trailer carrying a portable cabin to the chosen location



Complete Construction Kit FOR A *ClipperShip Model*

EVERYTHING you need to make a beautiful little miniature model of the famous American clipper *Sea Witch* is contained in a construction kit offered by the Popular Science Homecraft Guild. Unlike all previous clipper ship models, this one has been so greatly simplified that anyone can build it. Indeed, it is what is called a "pocketknife" model because so much of the work can be done with a penknife and a few single-edged razor blades.

The hull of the model is 9½ in. long, but the over-all length is 13 in., and it stands 8 in. high. The kit contains the hull carefully sawed to shape by hand from accurate master templates; half a dozen pieces of pine cut to approximate sizes for the deck fittings and boats; hardwood for the keel, stem, sternpost, rudder, and other parts; three sizes of round stock for the masts and spars; fiber for crosstrees and caps; thin hand-dyed linen rigging cord of the finest quality; thread, small chain, beads, fine wire, casein glue—in fact everything but the paint.

Postpaid Complete $1.50

Popular Science Homecraft Guild,
381 Fourth Ave., New York, N. Y.

Please send me a complete construction kit (except paints) and a blueprint for building a miniature model of the clipper ship *Sea Witch*. I inclose $1.50.

Name .....

Address .....

City..... State.....
(Print very clearly)

NOTE: This kit is not sent C. O. D.

tation logs, which are to be preferred.

Regardless of the type of siding you choose, the base construction will be the same. A studding frame for the siding first must be erected on some sort of foundation. If the cabin is to be used only in the warmer months, simple concrete piers will make a satisfactory base. A continuous foundation effect then can be obtained by filling in between the piers with a wall of native rock.

IF THE cabin is to be used the year round, there is no compromise for the continuous foundation. In fact, if the cabin is situated on the shore of a river or lake, a solid concrete slab foundation is the only solution to the heaving action of the earth. The cost of your foundation will depend on labor rates.

As to the roofing for your cabin, many inexpensive yet durable materials are available. Slate-coated roll roofing is one of the cheapest. Composition shingles also form a durable roof at low cost while regular cedar shingles, or "shakes," when they can be had, always give a picturesque touch to a low, squatting building.

At the start, there is no need to finish the interior walls of your cabin. The smooth inner surface of the siding, particularly the log siding, will serve as an attractive inside finish when stained.

Later on, if you decide to use your cabin for winter vacations and hunting trips, it will be a simple matter to apply the interior finish. If log siding has been used on the exterior, the log effect can be carried throughout by using it for the inside walls as well. On the other hand, if smooth walls are desired, knotty pine boards give a pleasing yet primitive appearance.

To improve the insulating qualities of the walls, a semi-rigid type of insulating material can be fastened between the studs before the inner walls are applied. It is inexpensive and will make your cabin snug and warm in the winter winds. Of course, if you desire, both interior finish and insulation can be combined by nailing rigid insulating board directly to the studs, covering the joints between panels with decorative battens. Partitions to form rooms also can be put up inexpensively by using insulating board.

Another type of summer cottage that is fast gaining popularity is the portable or so-called "prefabricated" variety. Made in small units, these cottages, ranging from small one-room cabins costing $200 to seventeen-room mansions selling for thousands, can be assembled anywhere by anyone mechanically minded enough to handle simple tools.

ASIDE from their low cost, small portable houses have another great advantage. They can be taken down and moved as quickly and easily as they can be assembled, making it possible to build your cottage on land leased for short periods.

If you plan a summer cottage in the near future, simply select your spot, decide on the plans, and let the amount you want to spend determine the materials you will use. Modern building methods have simplified the summer home question and made vacation cabins cheap enough for any lover of the outdoors.

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MAKES no difference whether it's water from a punctured radiator, leaky hose connection or cracked jacket, oil from a crack in the crank case, or gasoline from a leaky joint, Smooth-On No. 1 will make a perfect seal at almost no cost and with little effort.

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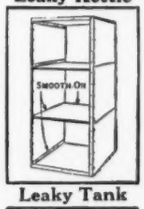

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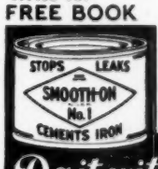

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Our Readers Say

He Wants To See What Makes It Tick

I SHOULD like to see some articles on watch and clock repairing in POPULAR SCIENCE MONTHLY, especially clock repairing. It is one of the subjects that the home tinkerer doesn't find much information on except in very expensive books.

Although most of us wouldn't attempt to repair a very fine watch, a little knowledge of how to repair alarm clocks, mantel clocks, etc., would come in handy. Of course I don't expect you to do this for me alone but I am sure plenty of readers would feel the same as I do if the question were put up to them in Our Readers Say.—G.S.G., Pittsfield, N. H.

Here's An Idea for Making Magazine Covers Last

OFTEN my copies of POPULAR SCIENCE MONTHLY get torn corners (the corners near the binding). To stop the fraying I decided to place a piece of adhesive tape about one and three-fourths inches long and one-half inch wide along the binding. I did this to all my copies of POPULAR SCIENCE MONTHLY. —J.M.W., New York City.

In Finland's Lexicon There's No Such Word

JUST want to say that W.H.S. of Chicago, Ill., is all wet or else he had a powerful imagination when he made up the Finnish word of 103 letters meaning "to bow". This word really has only eight letters, being spelled KUMARTUA. His other so-called Finnish words are also absolutely imaginary. I believe it is unjust to take advantage of a good magazine in that manner. Next time W.H.S. wants to publish words or names with so many letters he'd better get a patent on them first.—G.J.T., Buffalo, S. D.

Suggests Inoculation for Immunity to Snakes

IN YOUR recent article "Deadly Snake Poison Saves Human Lives," I read that an army officer, Col. M. L. Cummins, built up a partial immunity to snake bites by means of small injections of venom over a long period of years. My idea is this: Why couldn't a similar treatment be given generally to people living in sections where many snakes are encountered? It seems to me that by this means the danger would be greatly reduced.—P.M., Vayland, S. D.

Not Magnetism, Just Palpitation of the Heart

I READ Our Readers Say regularly and get a great kick out of it. In answer to G.P.K. in a recent issue, I say mebbe the reason for a change in the actions of the ring when held over a lady's hand is because the lady gets you nervous, making your finger move and so moving the ring. I am very much interested in short-wave radio and wish more articles were published on the subject. I especially wish you would publish an article on a simple one-tube transmitter.—R.H.P., Manatee, Fla.

The X-Ray Movement Gains New Support

I AGREE with M.P., Brooklyn, N. Y., when he asks you to publish an article on a home-made X-ray machine. I should like to experiment with one.—C.B.V., Chester, N. Y.

A Self-Styled Grouch Hails the Radio Razzberry

HAIL to the inventor of the radio voting machine! All we'll have to do now, it seems, is push a "yes" button to tell the broadcaster we like his program, and a "no" button to say we don't.

I'm afraid a crochety old grouch like myself will have his "no" button permanently wired down. Suppose you pick up a program you like, tuning at random. If it's a fifteen-minute program, the law of averages says you have an even chance of enjoying it for seven minutes. Then heaven knows what's coming next. You may sit down to supper with a good dinner music program going, and then have to get up again to tune out a lecturer on the care and feeding of catfish. Here's a free hint for broadcasters—why can't they get together so that one station will broadcast a continuous series of talks; another, nothing but dance music; a third, classical selections only; and so on? Then you'd have a fair chance of hearing what you wanted.—J.L.H., New York City.

Even Stalactites Grow Faster in Busy New York

IN THE May issue of POPULAR SCIENCE MONTHLY there was an article telling of the formation of stalactites in the abandoned tube of the old London subway. However, there are stalactites to be found much nearer home. A New Yorker does not have to go to London or even to the famous limestone caves found in some of the southern states in order to see these calcium carbonate icicles. All he has to do is to pay a nickel and go into the 145th Street station of the Eighth Avenue subway and he will see, hanging from the beams over the outside tracks, quite a few small stalactites. The largest are about five inches long. I knocked one down with a stick and tested it with acid. Carbon dioxide was given off, proving that the hanging objects were really limestone.—S. L., New York City.

Maybe Depth Bombs Would Be Simpler

IN ANSWER to the plan of C.E.P., Milford, Conn., for a paint that would kill barnacles by releasing deadly fumes, I think he should fix up a photo-electric cell that would detect the presence of the barnacles. It could be made to open a few holes in the side of the ship whenever barnacles appeared, and let out chlorine or some other poisonous gas which would kill them and rid your ship of barnacles.—D.B.L., Larned, Kans.

Now We Must Harness the Power Hidden in the Coffee Bean

I WISH to draw the attention of the chemists whose articles appear in your magazine, to a remarkable property in coffee—one that may have some industrial value but strangely enough does not seem to have received notice. Coffee grounds in a pot on the range will every few minutes produce an explosion that lifts pot and all up with a bang, indicating a property other than that recognized in its use as a beverage. The implication is, of course, that there is fire in the range.—A.R.W., La Gloria, Cuba.

An Article to Please V.A.H. Begins on Page 49

SOME articles on the navy would be very interesting with the new naval building program coming on. Give us some pictures of the latest ships, all sizes, and from all angles. Show us the mechanical side, the engines, the structure.—V.A.H., Long Beach, N. Y.

Gangsters Beware of the Basement Armory

BEING very much interested in your home workshop articles, I would like to offer a few suggestions that might be used. Why not draw plans for a suit of armor like those worn by the knights of yore? You could probably get them from some museum and so take the measurements from the real thing. Another suggestion is a model of a steam threshing engine. I think this would be rather simple in comparison to model locomotives, and yet make a very attractive piece of mechanical work. Another model that would

Gem GIVES YOU A PROFESSIONAL *Barber-shop shave*

When the barber shaves you, he tightens the skin with his stretching fingers to avoid nipping or scuffing facial contours and irregularities.

Gem's flat, slanted, bevel-sided razor enables you to reproduce the barber's technique for yourself. It irons out wrinkles, brings the stubble upstanding to the blade edge at root level, without skipping a hair in a cleft or dimple.

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Therefore you can *safely* use Gem's *sharper* and *deeper-edged* blades. And because Gem Blades *are* so incredibly keen, they wade through the wiriest bristle without irritating the tenderest skin.

Gem works with the barber's long, gliding, full-contact stroke—instead of the criss-crossing, mincing action of incorrectly designed razors, which leave so many men sore *at* and *from* shaving.

Super-tough, *rigid* Gem Micromatic Blades —single and double edged—are made of 50% thicker surgical steel and stropped 4840 separate times. They last so much longer than flimsier blades that cheaper substitutes are extravagant.

Beautifully boxed sets, with 24-karat gold-plated, one-piece frames (guaranteed *forever*) $1 everywhere. Or a trial outfit with the same holder and two blades in a smartly boxed testing outfit for 25¢ and this coupon.

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CLIP

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ADDRESS_____

GEM MICROMATIC *Razor and Blades*

be a big attraction is an old-time cannon which could be used as a mantel decoration or for a library table.—J.D.C., London, Ont., Canada.

Narrow Cellar Doors Can't Stop This Boat Builder

I HAVE been all winter building your 15½-foot sport boat. I have only a ten-horsepower motor but it pushes the boat at a surprising speed. The boat is very graceful and has been the cause of much favorable comment. An interesting fact concerning this boat is that it was assembled in my workshop in Auburndale, then knocked down and reassembled in Framingham where the cellar door would permit removal of the boat intact.—H.F.D., Auburndale, Mass.

A Reader Suggests Weaving As a New Hobby

IN ONE of our social centers here, a movement is on foot to bring back the ancient and interesting art of weaving on the hand loom. Our school authorities have brought in a man who is an expert at the work. Here, it seems to me, is a hobby that shows great possibilities. It would furnish pastime for women and children as well as for men and boys of all ages, and would also stimulate a feeling for beauty. The field of design is a great one and there are no stop-lights on the highway of new and interesting color schemes and motifs. Besides, some folks may even find a market for some of their work and so a few pennies may come in for those who need and could use them. I believe that an article in your magazine describing the construction of a simple loom that a homecrafter could easily build would not be a waste of space.—G.P.J., Milwaukee, Wis.

An Official Publication for Chronic Kickers

I THINK it would be a good idea for all the kickers to get together and publish a magazine. Maybe they would be satisfied then, and I sure would like to see the magazine.—D.S., Liberal, Kans.

Try a Built-in Oxygen Tank for Sunday Driving

PERHAPS some of your readers who are familiar with automotive developments can tell me when we can expect to find air-conditioned cars on the market. Buildings and railroad coaches have been designed and built to give the occupants air of uniform purity but we motorists have to struggle along with the same old dusty, fume-filled automobiles and run the chance, besides, of carbon monoxide poisoning. Lately we have been given new ventilating systems but all of them require that the windows be opened. Anyone who has driven along our congested main roads on a holiday knows that open windows are no boon when thousands of cars are choking the air with exhaust fumes. If railroads can condition the air in their coaches without raising fares, why can't we have air-conditioning in automobiles of moderate price? This would be more appreciated than a lot of the gadgets they are putting on cars these days.—M.N., Harrisburg, Pa.

You Have To Know Your Botany If You Want to Be a Bee

HERE'S a puzzling thing I wish some reader would explain for me. I have been told that a honey bee always flies from one flower to another flower of the same kind. This is probably nature's way of keeping plants from being mixed up by bees carrying pollen from one kind of flower to another of a different species. What I want to know is this: How do the bees recognize different kinds of flowers? Is it by smell? By sight? By feeling? Also, when a bee carries honey back to the hive and starts out again, does it begin on the same kind of flower or on some other kind?—A.C., Fort Wayne, Ind.

Ship Model Made Seaworthy for Bathtub Voyages

BY MAKING a few changes in the plans for the construction of your simple model of the clipper ship *Sea Witch,* I have made a ship that can be either sailed in the family bathtub or used as an ornament. In the first place, I made the ship lighter by hollowing the halves of the hull before fastening them together. Another change is a steel keel instead of a wooden one, for ballast. I added silk sails, gluing them to the yards, and as they were too small to hem properly I touched the edges with shellac. Having no waterproof glue, I used the ordinary kind and covered it with shellac when it was dry. The cardboard bulwarks were given two or three coats of paint to make them waterproof. The ship floats exactly at the water line and the sails give it a very realistic touch. To go with the model when used as an ornament I printed the history of the *Sea Witch* on a paper about 1½ inches by 3 inches, leaving a margin at each end which I rolled up to make the paper look like a scroll. I made a seaman's chest just large enough to hold the scroll. One end of the scroll I glued to the bottom of the chest, and the other to the lid, so that when the chest is opened the scroll stands out and can be read quite easily. The chest is complete, even to a pair of wooden hinges and a wooden hasp. I have had both the ship and the chest on exhibition at the high school. Now that I have succeeded in constructing a fairly simple model successfully, I feel ready to begin a more difficult one.—E.H.L., Yucaipa, Cal.

Also Disregard What Happens to the Elevator

I HAVE pondered over a number of problems presented in Our Readers Say, so I feel it is now my turn to suggest a problem. This is a theoretical problem of physics which, I believe, requires only an understanding of the basic laws of physics and a little reasoning: A spring balance and an even balance each have a 100-pound weight balanced on them and are enclosed in an elevator at the top floor of a skyscraper. This elevator is allowed to fall unhindered. Disregarding the influence of friction and air resistance, what would be the theoretical reading of each of the two balances?—D.J.Q., New York City.

More Light on the Hot Radiator Problem

J. W. R. of New York says that the mysterious moving shadows seen over a hot radiator are caused by dust in the air. I think he's all wrong. This same effect may be observed over a plowed field or almost any object that is being heated. A piece of hot iron held to the light gives the same effect. This phenomenon is simply a matter of differences in refraction of light. A hot gas gives an amount of refraction different from that produced by a cooler gas. Since these gases are constantly changing above any hot object, anything viewed through them appears to be moving. I was interested in your article on midget racing autos and would like to hear more about them.—G.S., Lytton, Iowa.

Deer Heads Not So Dear If You Mount Your Own

JUST a word of thanks for the article by Leonard F. Merrill telling how to mount a deer head. It was published at an opportune time for me, as I got a deer head the following month and couldn't afford to pay the usual price for having it mounted. The total cost of the finished product was $2.75 as against the $20 charged by a taxidermist. At the same time, I wouldn't take $20 for the head, as I'm proud of it and had considerable pleasure doing the job myself.—W.D.D., Newark, N. J.

Expansion of Metals Should Be Put To Work

WHEN I read some of the wild-eyed schemes being proposed to tap new sources of power, I wonder why engineers have left one palpable and tremendous source practically untouched. I refer to the expansion powers of metals which so far have been harnessed successfully only in such small instruments as thermostats and barometers. No doubt someone has tried to work out the principle on a large scale. It seems to me that large masses of zinc and lead, the metals which expand most, could be placed in spots where the temperature variation between night and day is considerable and made to yield continuous power, much as does the spring in a clock. Harnessing this energy by mechanical means would seem to offer no insurmountable problem. If I'm haywire, I'd like someone to put me straight.—S.E.J., Los Angeles, Calif.

Where Does the Sun Get Its Oxygen?

HERE is a problem that has been bothering me for some time. The sun is a burning mass, and combustion requires oxygen. Is the sun surrounded by an atmosphere containing oxygen or by a vacuum? If by a vacuum, how does the burning take place?—C.F., Chicago, Ill.

Now He Wants a Cruiser With Radio Control

I AM an ardent model maker, and having made the *Preston* and *Texas* models I am looking forward to a radio-controlled model of one of the latest of Uncle Sam's 10,000-ton cruisers. This is a big order, but I don't think it is extraordinary for POPULAR SCIENCE MONTHLY. May I suggest that such a model built to a scale of about 1/10 inch to 1 foot would be suitable for carrying the necessary lightweight radio equipment? I hope you will come through with such a model soon. There must be many other model makers who would welcome it.—F.J.F., Malden, Mass.

ROMANCE LOST—AND FOUND

REMEMBER YOUR WEDDING TWO YEARS AGO AND HOW I CAUGHT YOUR BRIDAL BOUQUET? AND NOW I'M TO BE MARRIED, TOO
I HOPE YOU'LL BE HAPPY, LOIS— HAPPIER THAN CARL AND I ARE
BUT I DON'T UNDERSTAND. CARL WAS CRAZY ABOUT YOU
YES, WAS... BUT NOT NOW. LATELY HE'S CHANGED...SO COOL IT'S BREAKING MY HEART
YOU CAN WIN HIM BACK, DARLING. GO "ROMANTIC" AGAIN! DRESS UP FOR HIM THE WAY YOU DID BEFORE YOU WERE MARRIED. BE CAREFUL ABOUT "B.O."
"B.O."—SURELY YOU'VE NEVER NOTICED...
JUST ONCE IN A WHILE. IT'S SO VERY EASY TO OFFEND. WHY NOT PLAY SAFE THE WAY I DO AND USE LIFEBUOY?

"B.O." GONE— *no happier couple in town*
ALL PLAYED OUT THIS HOT DAY, HONEY?
JUST A LITTLE— UNTIL I HAD A GRAND REFRESHING BATH WITH LIFEBUOY
SEE, A CARD FROM LOIS ON HER HONEYMOON. WASN'T SHE SWEET IN HER WEDDING DRESS?
NOT HALF AS SWEET AS MY WIFE IS

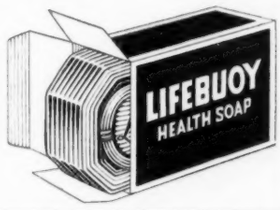
THINK of every quality you desire in a toilet soap. *You get it in Lifebuoy.* Lather? Oceans of it—in hot, cold, hard or soft water alike. Mildness? Lifebuoy's gentle, creamy lather is *super-mild*—kind to every skin. Protection? Yes, *extra* protection. Lifebuoy's rich, searching lather cleanses deeply—purifies and deodorizes pores—stops "B.O." (*body odor*).

NRA CODE

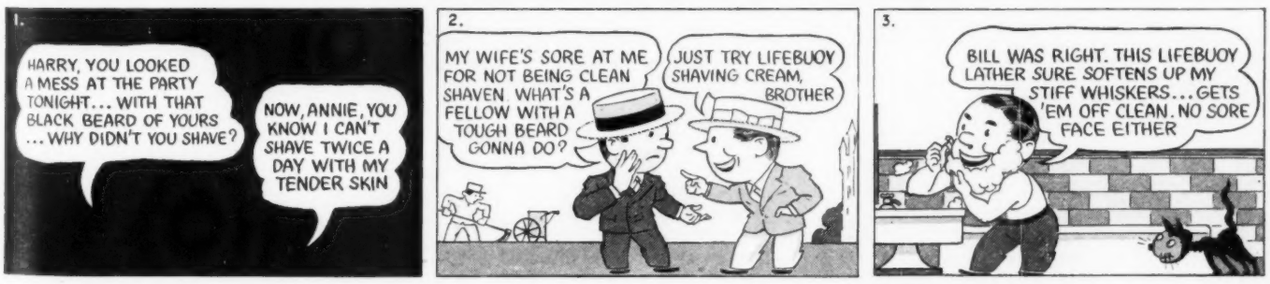
Note its hygienic scent

Lifebuoy is so different from ordinary toilet soaps it even *smells* different—a clean, pleasant scent that vanishes as you rinse. Play safe these hot days when it's so easy for "B.O." to offend—bathe regularly with Lifebuoy.

Approved by Good Housekeeping Bureau



ANNIE DOESN'T SCOLD HIM ANY MORE


1.
HARRY, YOU LOOKED A MESS AT THE PARTY TONIGHT... WITH THAT BLACK BEARD OF YOURS ... WHY DIDN'T YOU SHAVE?
NOW, ANNIE, YOU KNOW I CAN'T SHAVE TWICE A DAY WITH MY TENDER SKIN
2.
MY WIFE'S SORE AT ME FOR NOT BEING CLEAN SHAVEN. WHAT'S A FELLOW WITH A TOUGH BEARD GONNA DO?
JUST TRY LIFEBUOY SHAVING CREAM, BROTHER
3.
BILL WAS RIGHT. THIS LIFEBUOY LATHER SURE SOFTENS UP MY STIFF WHISKERS... GETS 'EM OFF CLEAN. NO SORE FACE EITHER

Snappy shaves—happy shaves with this extra-moist lather

A tough beard and tender skin won't bother you a bit when you use Lifebuoy Shaving Cream. Its lather holds 52% more moisture—quickly soaks wiry whiskers soft. Soothes and protects tender skin. That's why Lifebuoy gives the world's cleanest shave—leaves the skin soft and smooth. Try it.

Get the big red tube at your druggist. Or write Lever Brothers Co., Dept. A-148, Cambridge, Mass., for a free 12-day tube. (*This offer is good in U. S. and Canada only.*)

NRA CODE

"Few women care to be seen with a man *who needs a shave*"

SAYS GRACE PERKINS, FAMOUS AUTHOR OF "NIGHT NURSE"

GRACE PERKINS

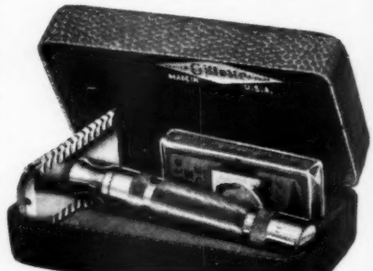
Who can blame the girl for walking out on the party! Women agree that the humiliation of a half-shaved escort is hard to bear! Few people will deny that stubble is inexcusable—yet many men risk the respect of others by failing to shave well and often.

Let Grace Perkins, the famous author of "Night Nurse," and other best-selling novels give you the woman's viewpoint. "Few women care to be seen with a man who needs a shave," says Miss Perkins. "If a man hasn't enough respect to shave carefully before he goes out with a girl, he cannot value her friendship very highly. I don't think anyone would blame her for not seeing him again."

Made for tender skin

With today's Gillette "Blue Blade" there's no excuse for stubble. Here's a razor blade that's made for men with tender skin. It is especially processed to permit clean, close shaving every day—or twice a day, when necessary, with perfect comfort. Special automatic honing and stropping processes give the "Blue Blade" its marvelous, free stroking edge. No other razor blade is produced by this exclusive method. Only today's Gillette "Blue Blade" can give you the keenness that makes frequent shaving so much easier—so much more pleasant.

If you haven't a Gillette razor, or need a new one, ask your dealer for the "Red and Black" Special—or see coupon below. **Remember—the Gillette Razor with its flexible blade, is adjustable to the special requirements of your beard.** A slight twist of the handle adjusts the blade to the exact shaving edge desired for clean, close shaving. Without this essential feature no razor can be entirely satisfactory.



Gillette
BLUE BLADES
Now **5 FOR 25¢**
10 FOR 49¢

Gold-Plated Gillette Razor and 5 Gillette "Blue Blades" Only 49c

● Heavily gold-plated with new-style "husky" handle. Comes in handsome red and black case with 5 Gillette "Blue Blades." If your dealer cannot supply you, send coupon and 49 cents to:—
The Gillette Safety Razor Co. Boston, Mass.

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Hear Gene and Glenn on the air every night except Saturday and Sunday. WEAF and coast-to-coast hook-up: 6:15 E. S. T. or 9:15 C. S. T.

POPULAR SCIENCE Monthly

AUGUST 1934 VOL. 125 No. 2

RAYMOND J. BROWN, Editor

Auto-Stealing Racket

SMASHED BY NEW METHODS

SENSATIONAL new pages are being written into the record of science's war on crime. Police of the nation have joined to crack down on the $50,000,000 automobile-stealing racket. Scientific methods of crime detection are the keynote of this new offensive. Red-hot telegraph wires flash cryptic messages as the search for criminals is launched in every state. In a single Eastern file, for instance, there are the records of more than 20,000 known automobile thieves, ready for instant use.

Police tips, fingerprint ciphers, and code numbers, giving clues to puzzling crimes, pour into linked police headquarters. Fingerprint cameras explore the surface of stripped cars for evidence. Mechanical brains construct a hypothetical thief, and then, from thousands of records, select the known criminals who might have committed the theft.

By STERLING GLEASON

HANDING OUT THE HOT SHEET

This radio patrol officer is receiving the daily list of stolen cars before he starts out for his tour of duty

CAUGHT IN THE TOILS OF THE POLICE DRAGNET

Deputy sheriffs, cruising in search of stolen automobiles, stop a car for examination. Inset shows a typical "hot sheet" used by the Los Angeles Police Department to inform its men of missing cars. Such a list is supplied daily to every man on the force

Scientific Methods Employed in War on "Hot Car" Gangs

Captain Scholle of the Los Angeles Police Department demonstrates his "crime map" showing thefts and recoveries of cars. Clusters of pins mark the work of organized car-stealing gangs

Chattering teletype machines and short-wave radio messages outdistance the fleetest car, while police encircle a fleeing criminal in an effort to make escape impossible.

In the first quarter of 1934, auto thieves found their racket a losing one. At Chicago, where auto insurance rates are among the highest in the country, the number of cars stolen has dropped forty-three percent. Car stripping was cut two-thirds. Salt Lake City police report that every car stolen last year has been recovered, while since 1928, the number of thefts has dropped fifty percent. In every state, mobs have been broken up; their dies for altering motor numbers, their stolen license plates, and their chemicals for counterfeiting identification papers, have been confiscated, and many of the crooks are serving long prison sentences.

Recent raids have smashed the Eastern ring specializing in high-priced cars for export to China, Persia, Siam, Norway, and half a dozen other countries. This gang maintained a staff of fast-moving sales representatives abroad. It employed specialized workers for removing serial numbers and substituting new ones. At its headquarters in Trenton, N. J., it had a fully equipped plant replete with special machines for disassembling cars and crating parts.

TWO hundred and fifty thousand expensive automobiles, according to the best available estimates, were shipped abroad by this and other gangs during 1932. They represented a loss to insurance companies of $75,000,000. The concerted drive of the police, Department of Justice agents, and the operatives employed by insurance companies has now virtually wiped out this type of racketeer. One proof of this fact is found in recent statistics. Only high-priced machines were stolen by the export mobs, and recent figures show thieves are leaving costly cars alone and are concentrating on low and medium-priced machines.

A police officer using the teletype to broadcast an alarm for a stolen car. News is flashed to many points

To learn at first hand how science is aiding in the war on the hot-car racket, I visited the offices of Captain Scholle, chief of the auto theft detail of the Los Angeles Police Department. Out of his headquarters works a force of picked detectives who have succeeded in breaking up many thieving gangs. His men are specialists in stolen cars. Some know how to use the acetylene torch, the microscope, and chemical processes to wrest from the fibers of the metal the secret of altered serial numbers on cylinder blocks and other parts. Others have a special gift for recognizing disguised automobiles, and know how to look for scrambled cars, made up like jig-saw puzzles from parts of other stolen machines.

In Captain Scholle's office hangs a crime map of the city. Studded with bright-colored pins, each indicating where and when a theft was committed, this map has an uncanny way of revealing the key districts where the gangs are operating. When a cluster of pins betrays that professional thieves are active, pairs of roving detectives in ordinary passenger cars are detailed to cruise inconspicuously through the hot-zone area, watching parked cars and studying the actions of motorists. One team of these experts regularly brings in thirty to forty theft suspects a month. Such concentrated attention soon drives the hot spot from the map.

These special officers, however, are the scouts of the police army—not the rank and file; for the work of tracking hot cars is carried on by every man on the force. Every policeman carries a card bearing a daily list of stolen cars. Printed during the night, it is placed in the hands of each officer as he goes on his shift. Motor-cycle patrolmen clamp it to their handlebars as they mount their vehicles and speed away. It is clipped to the dash of the cars in which plain-clothes detectives cruise the streets, and is handed to officers in radio cars as they are detailed to their patrol. Uniformed patrolmen fold it so only the numbers show, and carry it in their hand as they walk their beat in various sections.

Other ingenious schemes keep the organization at top-notch efficiency. Working out of headquarters on secret orders, special officers in plain clothes drive hot cars through the city, that is, newly recovered machines whose numbers are still on the hot sheet. Such a decoy car will drive slowly past a radio patrol car or a policeman on his beat, giving him a good chance to read the license number. If he fails to notice the hot car, he gets more chances; but a series of penalties is invoked against him. Too many failures costs him his job. Severe discipline, perhaps, but through such methods, efficiency has become so high that ninety-five percent of all cars stolen are recovered.

Radio patrol cars play an important part in the war on auto thieves. In the photo above, a deputy sheriff is seen adjusting the radio set on a patrol car. Note "hot sheet" on dash

Another scheme, practiced only on special order from headquarters, is the blockade. A detachment of police officers in automobiles and motor-cycles swoops down on a certain area, blocks off key streets, and stops all traffic, searching each car

before releasing it. When a desperate criminal is at large in the city, the blockade is used to prevent his escape.

As it is estimated that every active car thief steals approximately half a dozen machines a month, rapid-fire work in nailing gangs is important. In New England and Eastern states alone, last year, 1,500 hot-car workers were put behind bars.

Sheriffs are also active in suppressing car thefts. During a recent period, one group of deputies actually recovered more automobiles than had been stolen within their district, the surplus representing those that had been brought in from outside by thieves with city confederates.

Figures compiled by the National Automobile Underwriters Association show that eighty-six percent of the cars stolen in 1930 were recovered, while in 1931 eighty-two percent were recovered and eighty-nine percent in 1932. Up to the middle of last year, the record ran close to eighty-eight percent.

SEEKING more information on how interstate gangs of auto thieves work their racket, I received new light from C. F. Cline, special agent of the National Auto Theft Bureau. This organization, supported cooperatively by the insurance companies of the country, is a powerful agency in smashing the big mobs whose underground channels move whole fleets of hot cars from state to state. Its under-cover operatives, working out of key cities where central offices form clearing houses for telegraphed reports and tips, are ceaselessly active in running down interstate shipments of stolen automobiles. Each agent is a master of the scientific methods of tracing hot cars.

"A thief can no longer disguise a stolen automobile so that experts cannot identify it," Cline told me. "Thieves usually file away the number stamped into the cylinder block and stamp a new one with dies. This ruse is useless, for when the original impression is formed, the particles of the metal beneath are pressed into a pattern which never disappears, even though the surface metal is filed away. Ordinarily, a touch of the acetylene torch will restore the original number. If not, the impression will soon respond to secret chemical processes."

Motor manufacturers are now putting secret serial numbers at dozens of places on their cars, hidden in inaccessible spots where discovery by a thief is almost impossible. These secret codes render identification of a stolen car by an expert inevitable, and make scrambling of cars futile.

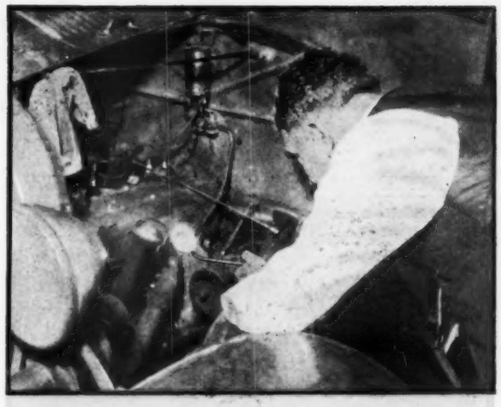
In Chicago, a central salvage bureau, maintained by insurance companies, is being established in an effort to wipe out a $10,000,000-a-year racket in stolen parts. Stripped cars, from which thieves have taken every removable part, will be renovated at the salvage bureau. In the past, insurance companies have paid owners for their loss and then sold the remains of the automobiles to the highest bidders. These buyers refitted the machines with cheap and often stolen parts. By junking or refurnishing the cars themselves, the insurance companies will wipe out a leading market for stolen parts.

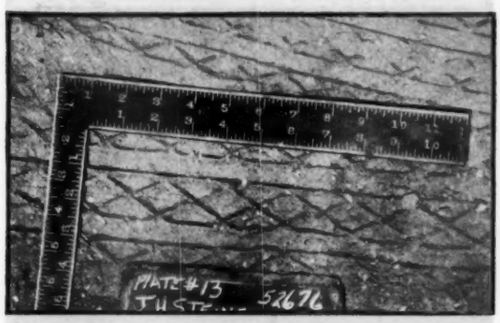
Even tire prints form valuable clues. In his laboratory at the Los Angeles Sheriff's office, Criminologist Frank Gompert has blueprints showing the tread designs of practically every tire ever made. By taking plastic impressions of tire prints and measuring them closely with calipers, he can trace the make of tire and often get the vital link that connects with the thief and leads to conviction.

In one instance, a difference of three sixty-fourths of an inch in the pattern of a tire led to the capture of an elusive California thief. Arrested on suspicion, he produced forged evidence to show that he had owned the car for more than a year. A close examination of the tires, however, gave positive proof that he was lying. Six months before, the company making them had widened the tread pattern a fraction of an inch. These tires, which had not been in existence at the time he said he bought the car, were the ones found on the machine. Trapped by this bit of scientific detective work, the crook was held for trial and detectives, tracing his activity, recovered more than $100,000 worth of stolen cars.

NOT always, however, are elaborate tests necessary to solve an auto theft. Split-second speed in flashing information from headquarters often spells the difference between success and failure. Radio, of course, plays a big part. Just the other day, two radio-car officers were waiting for a traffic signal to turn when the loudspeaker announced that an ambulance had been stolen from the receiving hospital. While the announcer was still speaking, a long black car drew up beside the pair. It was the stolen ambulance! The officers captured the thief, who had succeeded in getting only five blocks from the scene of the crime during the few seconds since the theft was committed.

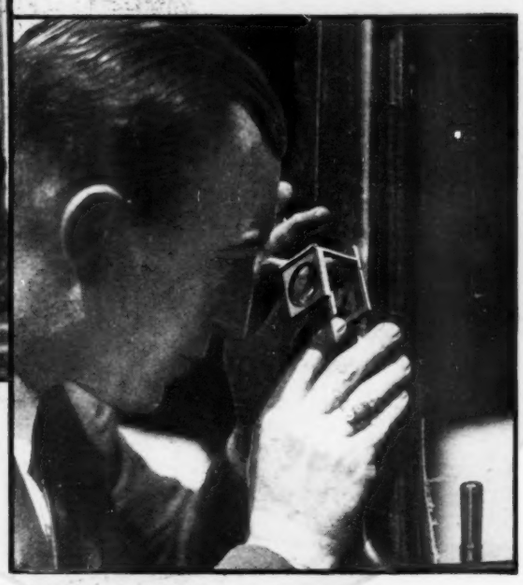
In another *(Continued on page 116)*





Above, experts are treating a cylinder block with a torch to restore the original serial numbers filed away by thieves. Below, accurate measurement of these tire prints led to the detection of a thief

Hidden Fingerprints Give Clues to Auto Thefts



Left, developing a fingerprint on a stolen car with fluid and powder. Below, the print is being studied under a pocket microscope for checking with records of known thieves

Building Giant Tunnels *for*

By GROVER

At eight-foot intervals, this pantograph is used to mark the contour of the tunnel. As the long pointer moves over the wall, a pen scratches a record on board seen at center. Right, rescue worker with gas mask and oxygen tank

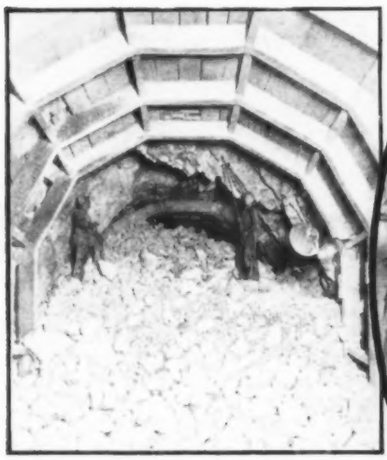
WRIGGLING across deserts and winding through mountains, the 241-mile aqueduct which in a few years will carry a billion gallons of water every twenty-four hours from the Colorado River to the Metropolitan Water District of southern California is being speeded to completion by ingenious devices and methods, many of which have been developed on the job.

The gigantic tunnels, sixteen feet in diameter, or large enough to accommodate a locomotive, of which there will be twenty-nine totaling ninety-one miles in length, are measured for size by large-scale pantographs, like those used by engineers and architects. As the pointer follows the contour of a sixteen-foot tunnel, another small pointer traces the contour in ink on a small board. Thus the engineers take instantaneously a permanent record every eight feet, O.K. the contractor's work, and send him tunneling ahead into a mountain.

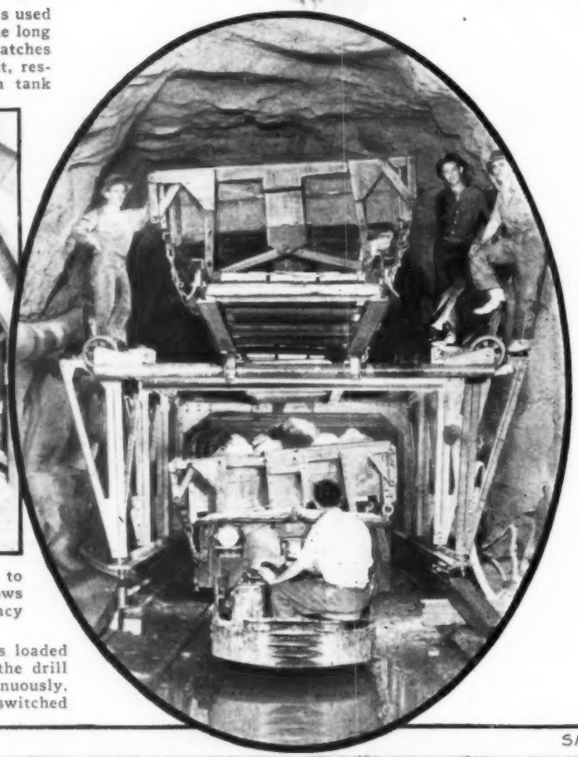
Some of the tunnels are so long—the East Coachella stretching eighteen miles without a break through the Little San Bernardino mountains—they must be started from several points at once—each end, the sides, and the top. With steel riblike structures, like those used in airplane wings, engineers measure the contours of lateral passageways before drillers begin to bore into hard rock.

One of the most ingenious devices is a "grasshopper," developed by H. J. King, a superintendent on the job. This is a large framework equipped with a sliding ramp on which empty cars inside the tunnels may be pulled up out of the way until loaded cars are removed. The grasshopper abuts the inner end of a tunnel, and on that end is fixed a series of drills. Thus it serves at once as an overhead car switcher and a drill stand for the boring machine.

Steel liner plate and vertical steel beams enable drill crews to bore rapidly through



Careful measurements make it possible to drill tunnels from both ends. Picture shows sections meeting with absolute accuracy



Right, "grasshopper" that switches loaded and empty cars and also carries the drill which is kept in operation continuously, even while the cars are being switched

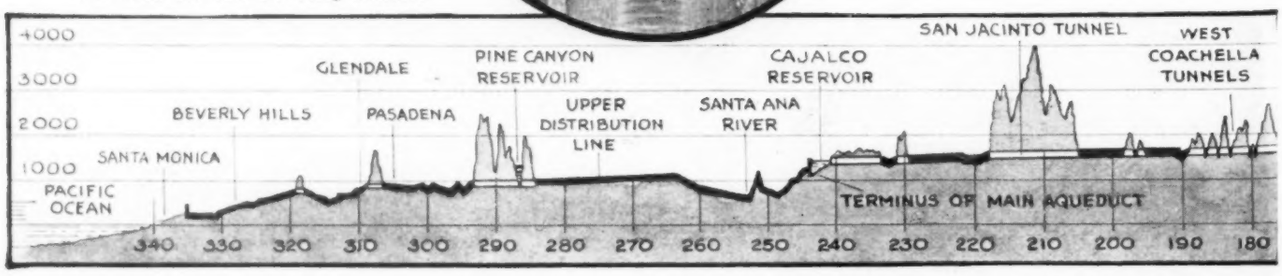


Illustration shows course, elevation, and nature of the giant aqueduct which will carry water

World's Biggest Water Pipe

C. MUELLER

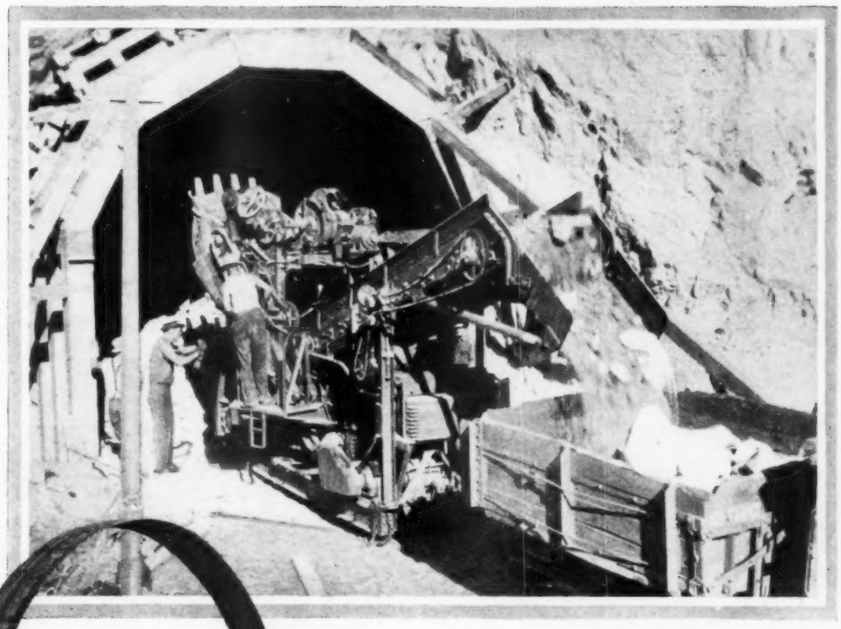
soft formations. By shoving the liner plate before them, they sometimes advance thirty feet in a day.

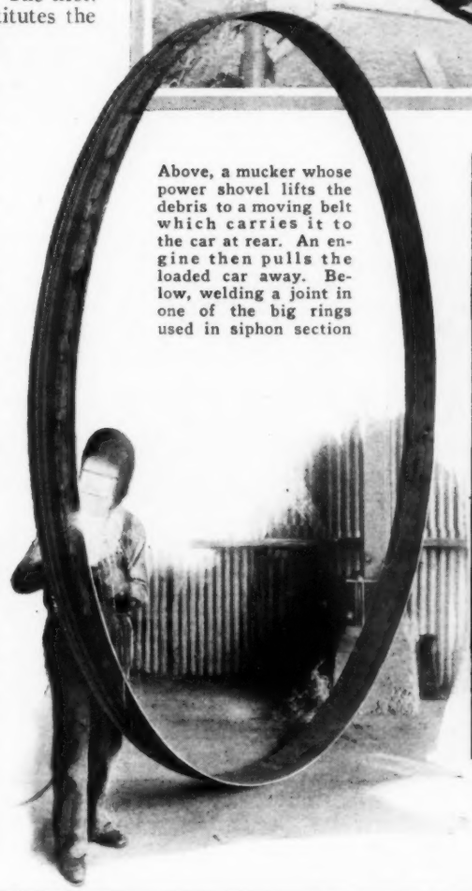
Always ready for possible disaster, rescue crews are equipped with flash lights, oxygen apparatus, stretchers, and life lines. In case of fire or other emergency, large conduits, through which as much as 6,000 cubic feet of air a minute may be pumped as far as three miles inside a mountain, begin to suck the air out at the inner end of a tunnel. This would permit rescuers to reach any point without danger to themselves.

The two most notable bores on the project are the eighteen-mile East Coachella Tunnel and the thirteen-mile tunnel through San Jacinto Mountain. The first, longest on the entire job, constitutes the major section of the Coachella Division. It is being excavated from four adits, or subsidiary tunnels, which have been driven into the mountainside at right angles to the main tunnel line. Each of these subsidiary tunnels enables two crews to work on the main bore, one crew going east and the other west. Thus, there are a total of eight crews working on the East Coachella bore simultaneously, rather than only two crews as would have been the case had the great tunnel been driven from its two portals only. The San Jacinto bore is being driven from its west portal and from two vertical shafts, one near Cabazon and the other in Potrero Canyon.

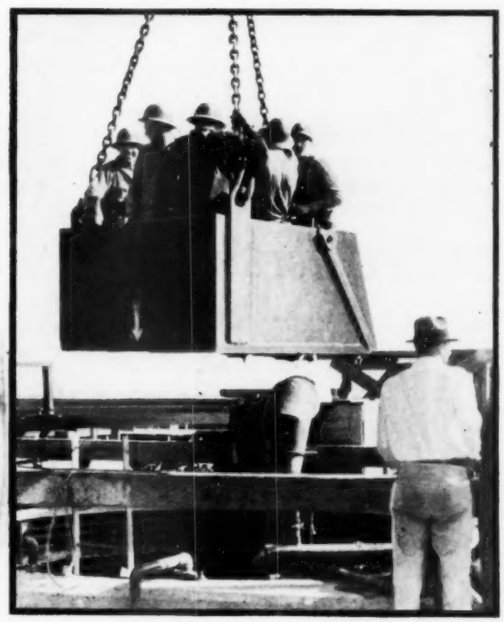
These shafts fulfill the same functions as the adits on the East Coachella Tunnel, the only difference being that the shafts are driven straight down to the tunnel line and the adits are horizontal to the tunnel line. From five to six years will be required to complete both of these tunnels, it is estimated. Among the other notable aqueduct tunnels are Valverde, seven miles; Iron Mountain, eight

(Continued on page 113)

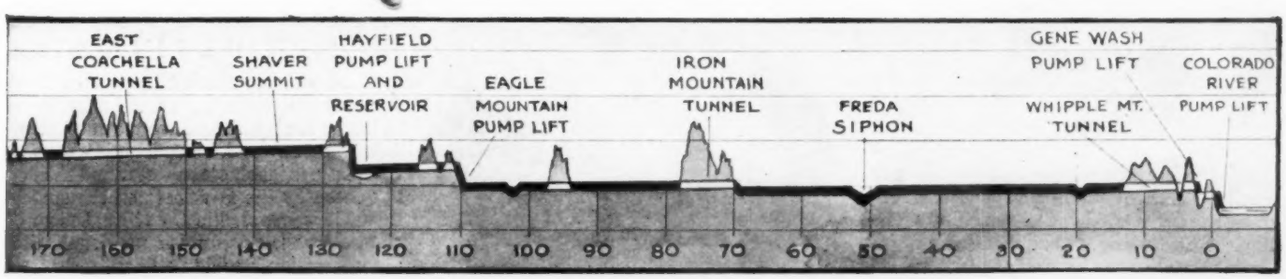




Above, a mucker whose power shovel lifts the debris to a moving belt which carries it to the car at rear. An engine then pulls the loaded car away. Below, welding a joint in one of the big rings used in siphon section



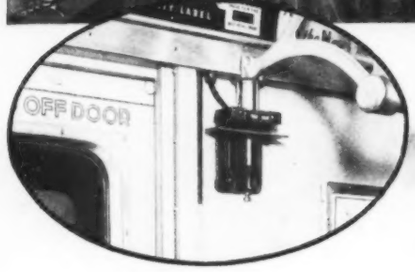
Vertical shafts, like this one, are sunk in the mountain and workmen descend them to drill a section of a tunnel lying between the two ends. Thus work is speeded

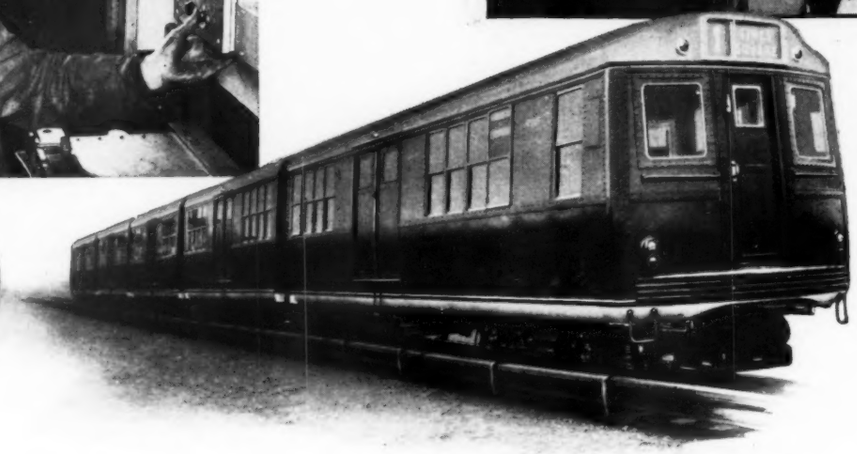

EAST COACHELLA TUNNEL
SHAVER SUMMIT
HAYFIELD PUMP LIFT AND RESERVOIR
EAGLE MOUNTAIN PUMP LIFT
IRON MOUNTAIN TUNNEL
FREDA SIPHON
GENE WASH PUMP LIFT
WHIPPLE MT. TUNNEL
COLORADO RIVER PUMP LIFT
170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0

across 241 miles of desert and mountain from the Colorado River to the cities in southern California

Fast, New Subway Train Run by One Man

Left, the motorman's compartment. He is seen pressing button that changes all destination signs throughout train. These signs are shown at right. Below, exterior view of the aluminum multi-section cars

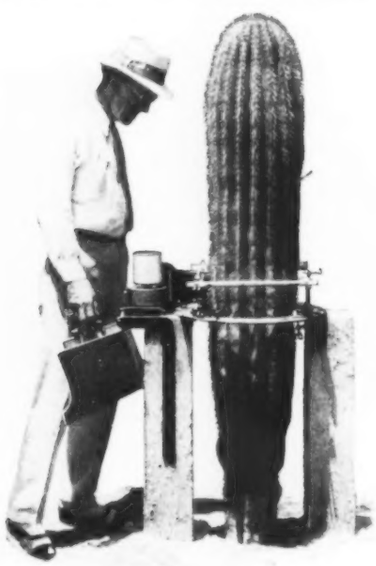




Chimes on new subway car, sounded as warning when doors are to close

Door chimes that warn the passengers when doors are about to close, and a ventilating system that changes the air at frequent intervals, are among the devices installed in an aluminum subway car just delivered for testing to the Brooklyn-Manhattan transit lines in New York City. All doors are controlled from the cab by the motorman, who, with mirrors, can see the whole length of the train. Push buttons enable the motorman to change destination signs, and to control the ventilating equipment. An electric eye inside the cab automatically turns off the lights throughout the car when it emerges from a tunnel, and turns them on again as it reenters an underground section of track. The car, made up of five sections jointed together, is provided with electrical apparatus to insure smooth stopping and starting. It has a fifty-four-mile speed.

CACTUS SHRINKS IF WATER IS SCARCE



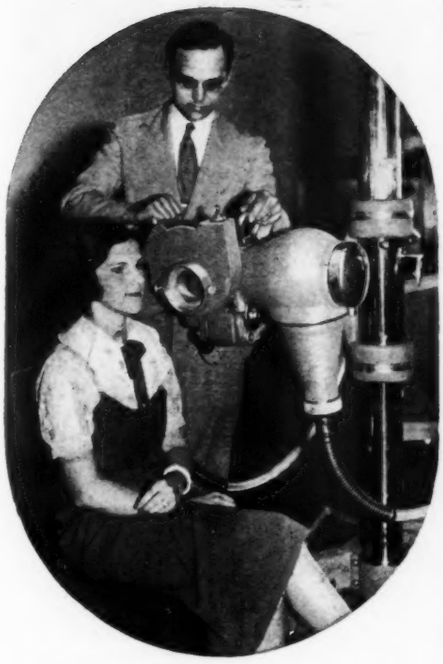
Although it can thrive on a surprisingly small amount of water, the cactus is extremely sensitive to the presence of moisture. A dendrograph that makes an automatic record of the growth of plant trunks has been used recently to measure cacti in the Arizona deserts. The records have shown that the size of the cactus plant changes rapidly as the supply of moisture varies. The dendrograph has been used heretofore in the scientific study of the trunk growth of trees.

TRIPLE TABLET INSURES CORRECT CARBON COPIES

Recently placed on the market is a three-in-one tablet that offers a convenient means of making carbon copies. Writing paper, carbon paper, and second sheets are bound into the tablet in successive layers. To use, the three layers are removed together and are instantly ready for use, eliminating finger smudging and the problem of getting the carbon paper right side up in the typewriter.

HIGH-VITAMIN FISH FOOD IS INSOLUBLE IN WATER

High vitamin content in a concentrated food for fish made from dried milk, is said to insure the health and growth of aquarium fish. The new food, made by a leading milk company, is insoluble in water and the food not eaten by the fish floats on the surface. Thus, it is impossible for the flakes to decompose as they would if they sank. Such decomposition is said to give rise to bacteria that cause various fish ailments.

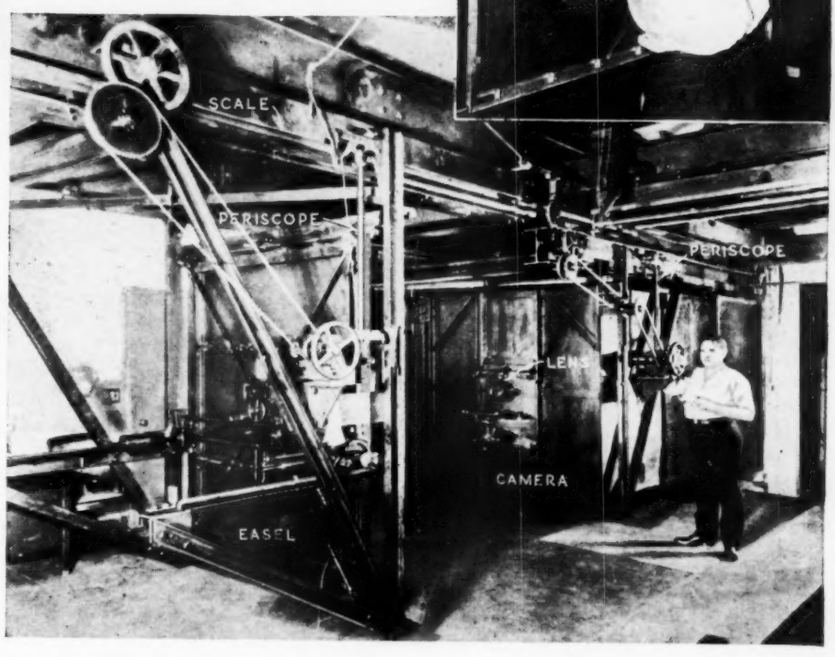


HIGH-VOLTAGE X-RAY OUTFIT EASILY MOVED

OPERATING on a 200,000-volt current, a mobile X-ray device has just been developed for treating cancer. Previous X-ray machines capable of using this tremendous voltage which is needed to generate rays of the required potency, were so huge that they could be used in only a few positions and the patient was therefore required to assume many uncomfortable postures. With the mobile machine, rays can be directed upon any part of a patient's body while the patient maintains one position. Lead insulation guards bystanders. A meter attached to the machine turns off the current automatically when the necessary number of X-ray units has been applied.

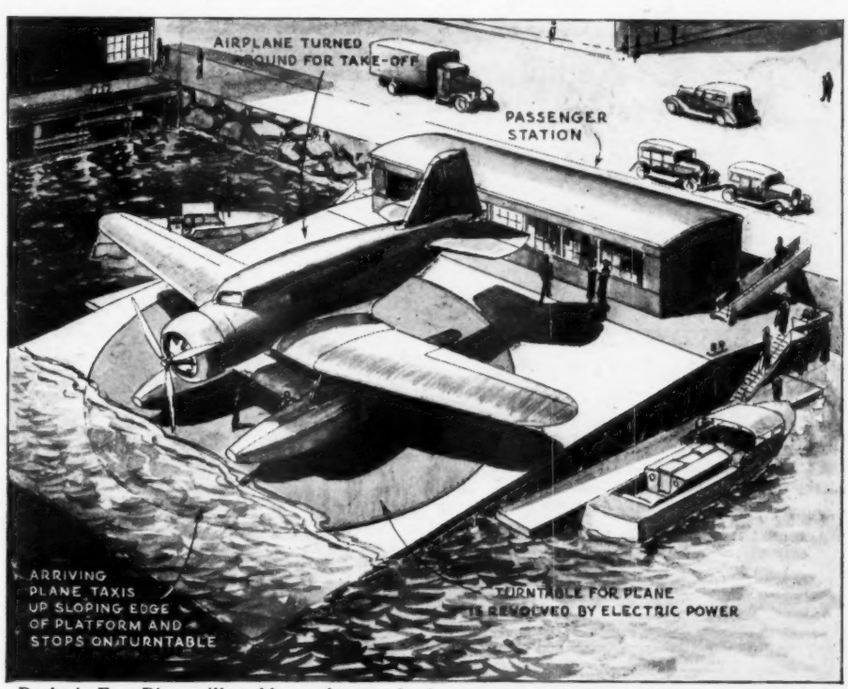
U. S. NOW HAS WORLD'S BIGGEST CAMERA

LARGEST of its kind in the world, a precision camera that weighs fourteen tons and is thirty-one feet long has just been placed in service by the U. S. Coast and Geodetic survey for reproducing the nation's nautical charts and airway maps. It copies them upon plates up to fifty inches square with no more error than the thickness of a sheet of cigarette paper, and with marked saving in time and cost because only a single exposure is required. Despite their weight, the easel and lensboard are rolled easily along their track by hand wheels, as shown below. The photographer stands within the camera, in a chamber at its rear, where he sensitizes, exposes, and develops the plate. He is shown in the smaller picture adjusting the final focus with the aid of a magnifying glass. It required two years to build the camera.



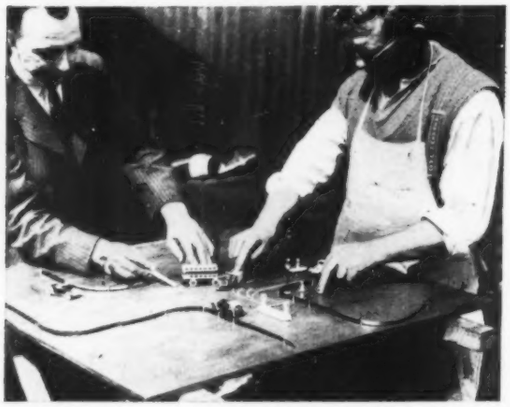
PLANES TO LAND PASSENGERS IN HEART OF NEW YORK CITY

WITH the completion of two landing docks, of radical new design, seaplanes or amphibian airplanes will soon be able to land passengers in the heart of downtown New York. These docks will be located on the East River. They are being built by a leading dock company and are sponsored by New York City officials. The landing stages of the new docks will be eighty-three feet long and each will contain a large turntable. The stages will slope down to the water at an easy angle and the lower quarter of the turntables will be submerged. In landing, a plane will taxi in at good speed and run up the heavy planking of the dock and turntable under its own power. There its position will be maintained by its propeller or brakes and the turntable will be rotated by a powerful electric winch, operating cables encircling the outer edge of the turntable. Within thirty seconds, the plane will be turned half way about and will be completely out of the water. Its passengers will be able to disembark without the use of a boat. Between the landing stage of each dock and the shore will be a building containing waiting rooms, ticket offices, and temporary quarters for the crew of the planes and dock hands. Air tanks support the outer edge of the float.

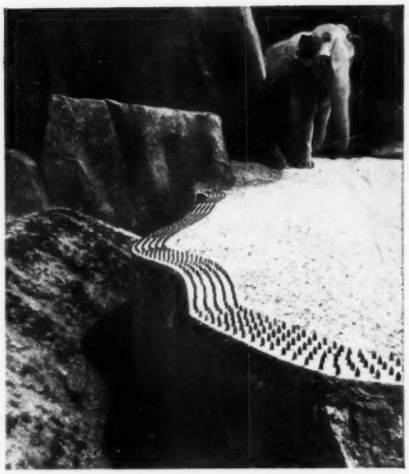

AIRPLANE TURNED AROUND FOR TAKE-OFF
PASSENGER STATION
ARRIVING PLANE TAXIS UP SLOPING EDGE OF PLATFORM AND STOPS ON TURNTABLE
TURNTABLE FOR PLANE IS REVOLVED BY ELECTRIC POWER

Docks in East River will enable seaplanes to land passengers in the heart of downtown New York

MODELS SHOW TRAFFIC SMASH IN COURT



COURT-ROOM reconstructions of traffic accidents can be made effectively with an ingenious English invention that can be adjusted to any traffic condition. The device has a square base containing hundreds of holes. Upon this base, street intersections are outlined with flexible steel tape held in place by wooden pegs inserted in the holes. Small models of street lamps, traffic light standards, and automobiles are used to demonstrate the movements of vehicles at the time of the accident that lead to the suit.



PRIMITIVE RAILROAD AIDS ROAD WORK

MODERN roads are being built in western Canada with the aid of one of the most primitive railroads in existence. The tracks are barked saplings laid end to end in parallel lines. Over this track horses haul a plank platform which serves as cars. Notches cut into the timbers supporting the platform keep the cars on the track. The system is used to carry away rock blasted from the hills crossed by the new roads.

SPIKES IN WALL HOLD BACK ZOO ELEPHANTS

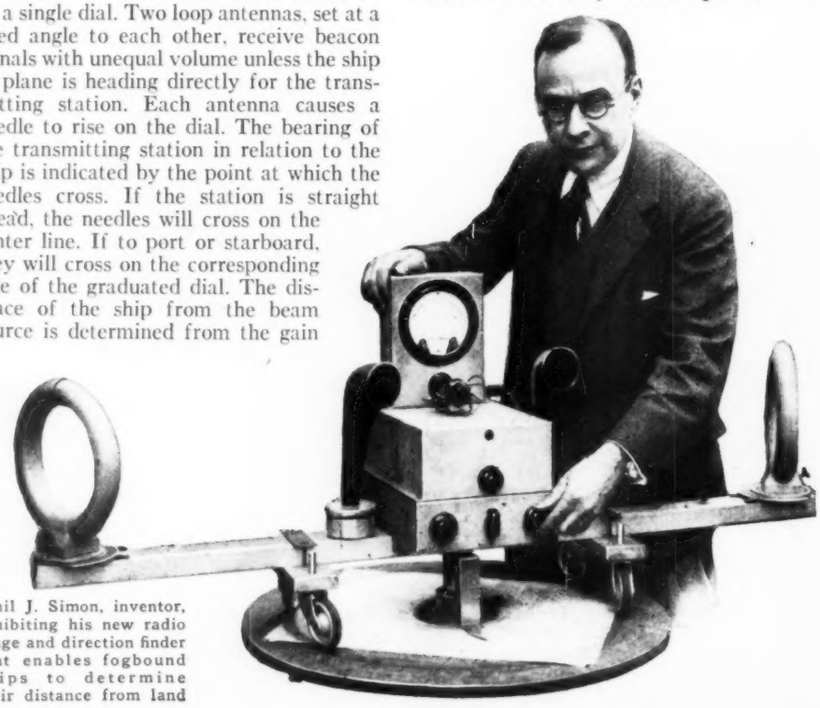
SHORT, sharp spikes embedded in a low wall are the means used in the Vincennes Zoo in Paris, France, to keep the elephants from escaping. No cages or bars are used in this modernized zoo, which permits the animals to roam in natural surroundings, dependence being placed on low walls, moats, and pits to prevent them from straying too far. The elephant enclosure consists partly of artificial rocks and partly of a low wall. An elephant coming to the wall and seeing the sharp drop on the other side explores the edge with his foot before stepping over. The sharp spikes stop him.

SMALLEST RADIO SET IS HELD IN LEAD PENCIL

DECLARED to be one of the smallest practical radio sets ever built, a receiver in the possession of a Western enthusiast uses a tuning coil wrapped around a pencil. The crystal detector is inserted in the metal eraser cap, to which is also attached the standing, pinlike aerial. For use the pencil radio is simply connected to a pair of earphones, as in the picture above, and is said to provide surprisingly good reception for its diminutive size and to pick up broadcast entertainment from stations at considerable distance.

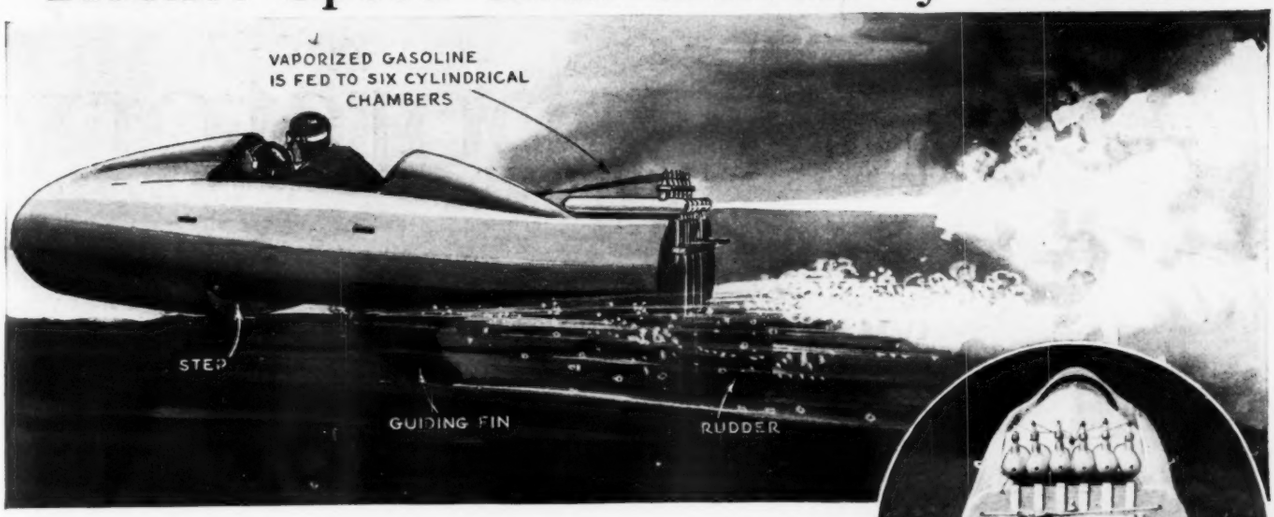
RADIO SHOWS SHIP DISTANCE TO LAND

EQUIPPED with a new radio direction and range finder that operates automatically, a steamship or airplane may now determine its exact distance from the transmitting station and so ride safely through a heavy fog. On the new instrument, invented by Emil J. Simon, New York radio engineer, both direction and distance are indicated on a single dial. Two loop antennas, set at a fixed angle to each other, receive beacon signals with unequal volume unless the ship or plane is heading directly for the transmitting station. Each antenna causes a needle to rise on the dial. The bearing of the transmitting station in relation to the ship is indicated by the point at which the needles cross. If the station is straight ahead, the needles will cross on the center line. If to port or starboard, they will cross on the corresponding side of the graduated dial. The distance of the ship from the beam source is determined from the gain in signal strength as the source is approached. As the strength increases, the needles move higher up the dial, and the rate of their climb shows the time that will elapse before the ship arrives at the signal source. Loudspeakers enable the beacon stations to be identified. A control knob insures the accuracy of the signals.



Emil J. Simon, inventor, exhibiting his new radio range and direction finder that enables fogbound ships to determine their distance from land

Rocket Speed Boat Driven by Gasoline



HIGH speed and safety are declared to be combined to a surprising degree in a Mansfield, Ohio, inventor's gasoline rocket speed boat, recently tested. A special fuel vaporizer developed by the inventor supplies fuel to six rocket cylinders mounted on the boat's stern. It is there ignited by spark plugs as it would be in a gasoline engine. Strength, necessary to withstand the force of the rocket discharges, is provided by a double stern. A guiding fin beneath the hull makes the craft unusually stable when in motion. Modern methods and remote control are said to eliminate most of the danger incident to testing this type of rocket propelled boat.

FOUR-INCH RADIO WAVES TRANSMITTED TWO MILES

RADIO waves only four inches long were successfully transmitted over the two-mile distance between Philadelphia, Pa., and Camden, N. J., the other day. This is reported to be the first time that signals of so short a wave length have been used outside the laboratory. An innovation demonstrated in the tests was the use of a glowing blue argon-mercury tube similar to those of advertising signs, to control the signals. It set up a miniature Heaviside layer resembling the electrified layer of the earth's upper atmosphere that reflects radio signals back to earth. Placed in the path of the ultra-short radio waves, it permitted their intensity to be regulated at will.

HEAVIEST AND LIGHTEST WOODS ARE COMPARED

AT A recent exhibition on the Pacific coast, the amazing difference in the weight of various woods was demonstrated. A girl, standing on a raised platform, balanced a log of balsa as tall as herself and a short length of kingwood. The log of balsa weighed far less than the bit of kingwood. Balsa is used in making model airplanes, floats, and airplane parts. Kingwood, sometimes known as violetwood, is used for veneers and cabinet work.

LAPEL MICROPHONE PICKS UP VOICE AT ANY ANGLE

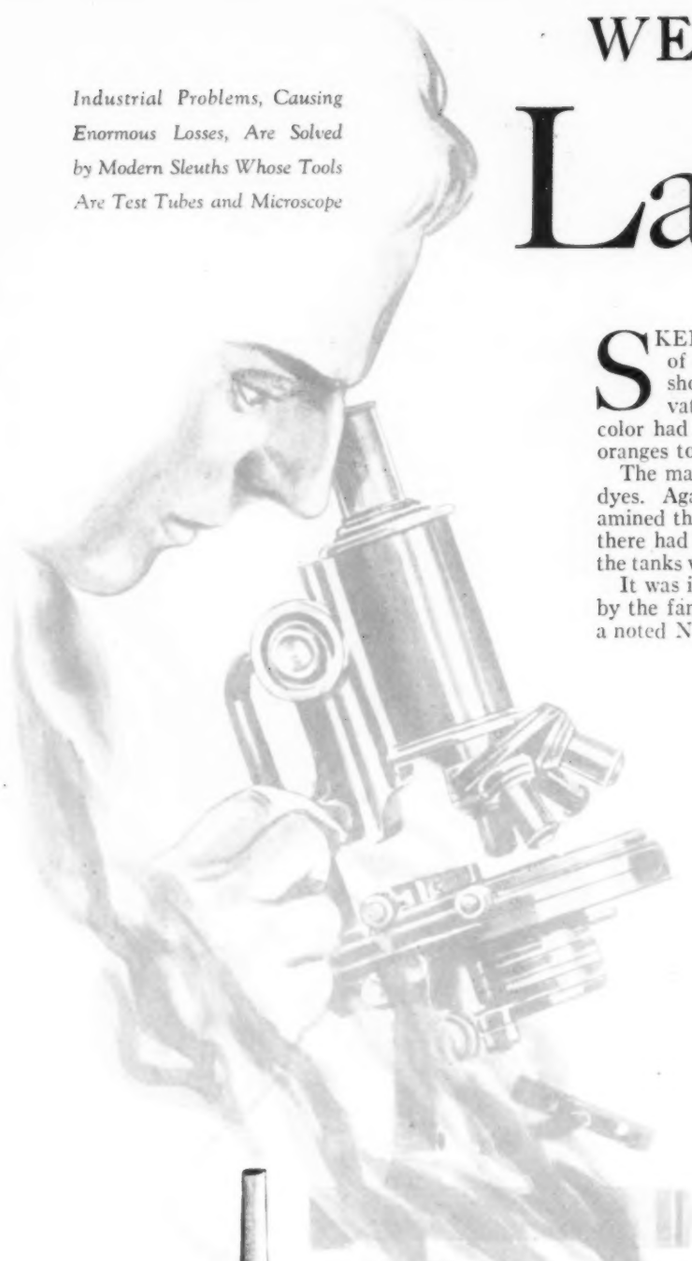
LAPEL microphones for public speakers are an innovation of recent years, and the latest one takes its design from the velocity type of microphone used in broadcasting. This microphone, employing a thin aluminum ribbon suspended in a magnetic field, is equally sensitive to sounds from in front or behind it. As used in the lapel, it has the peculiar characteristic of greatest sensitivity to the speaker's voice when his head is turned to either side away from the microphone that he is wearing.

Lapel microphone for public speakers that is sensitive to any sound from in front or behind it

WEIRD MYSTERIES

Laboratory

Industrial Problems, Causing Enormous Losses, Are Solved by Modern Sleuths Whose Tools Are Test Tubes and Microscope



SKEINS had begun moving toward the big vats in the dyeing room of a New Jersey silk mill, when an uproar arose. Orders were shouted to stop the machinery. Excited men ran from vat to vat. The tanks seemed bewitched. In them, delicate shades of color had shifted in bewildering fashion. Purples had turned to reds; oranges to yellows.

The machinery stopped. Workmen drained the vats and mixed fresh dyes. Again the colors mysteriously changed. The color mixers examined the dyestuff. It was the same as had been used for months and there had never been the slightest variation in its shade. A third time the tanks were drained, cleaned, and filled with new dye. The same result.

It was in the middle of the rush season and production was paralyzed by the fantastic behavior of the dye. The frantic mill owners called on a noted New York industrial chemist to solve the mystery. Out of his test tubes and retorts came a curious explanation.

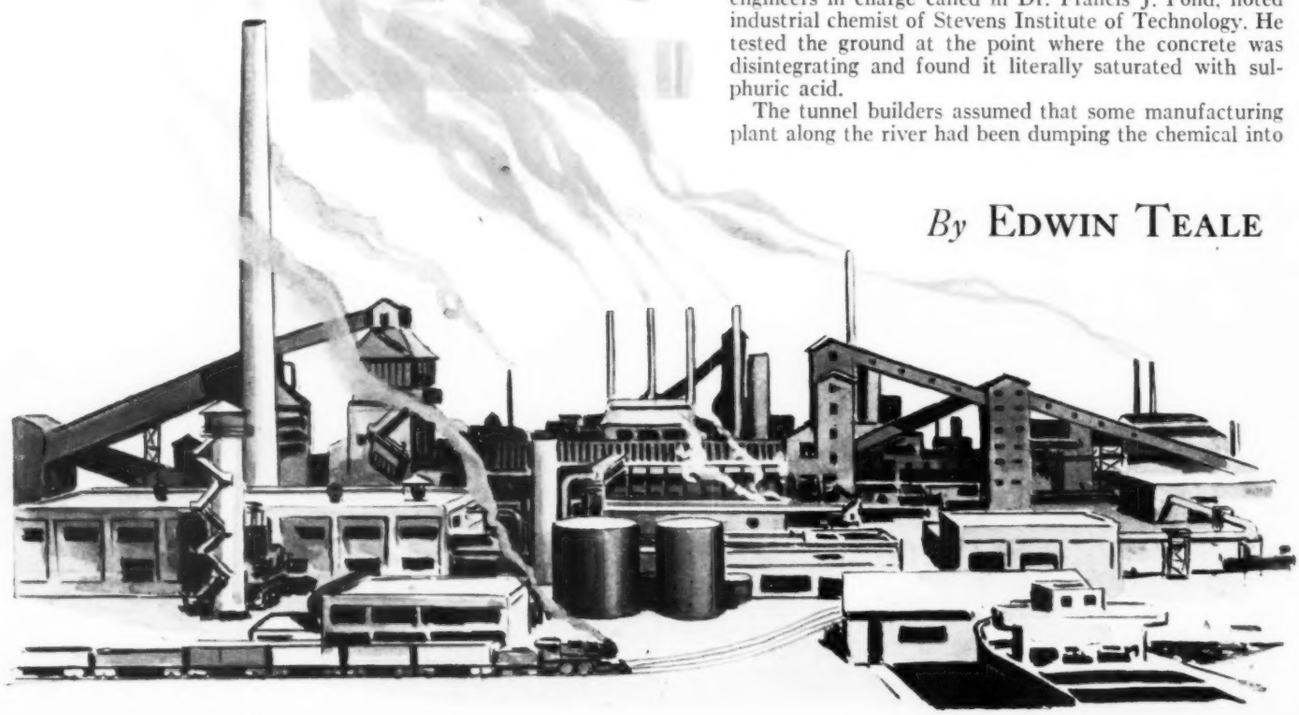
A few days before, the city water department had tapped a new source of supply which had been turned into the mains that reached the mill. Analysis of this water revealed that it contained an increased amount of alkali, carbon dioxide, and other ingredients which had thrown the delicate dyes out of balance and caused the shift in color. A treating plant was set up at the mill to remove the trouble-making chemicals and the difficulty disappeared.

Such riddles are everyday problems for the test-tube sleuths of industry. New products, wealth from waste, cutting costs—these are familiar feats of the industrial chemist. His exciting role of detective is often overlooked. Yet in such varied activities as baking bread, building skyscrapers, manufacturing cosmetics and constructing tunnels, laboratory men regularly solve problems that would baffle a Sherlock Holmes.

Some years ago, for example, workers were boring a tunnel under the Hudson River, at New York. Tons of concrete, installed on the New Jersey shore, mysteriously melted away, almost as fast as it was put in place. The engineers in charge called in Dr. Francis J. Pond, noted industrial chemist of Stevens Institute of Technology. He tested the ground at the point where the concrete was disintegrating and found it literally saturated with sulphuric acid.

The tunnel builders assumed that some manufacturing plant along the river had been dumping the chemical into

By EDWIN TEALE



SOLVED BY SKILLED

Magicians

MYSTERY OF CONCRETE STAINS

A dozen floors above the ground, mysterious stains appeared in the walls. This was traced to acid salts in cinders used in concrete

RIGID RAINCOAT

A manufacturer faced a serious problem entailing heavy loss, when his rubber coats became so rigid they could stand alone. Copper in the dye he used caused trouble

A PRICELESS CIGARETTE

An employee in a dye factory accidentally dropped some cigarette ashes into a solution of coloring matter and thus produced a powerful and valuable dye

SOAP SAVES PLASTER

A builder found that his plaster dried so fast the finishing coat could not be smoothed out. A chemist added soap and ended the difficulty caused by the fast drying

the water. Then investigation showed, though, that no near-by factory used sulphuric acid. Acids poured down drains in chemistry laboratories at schools in the vicinity could not account for the mystery. Where had the acid come from? Why was it at this one point and no place else?

Dr. Pond at last discovered a clue that led to the solution of the riddle. Years before, local gas companies had used the place where the concrete was being destroyed as a dumping ground for spent oxide of iron used in purifying the gas. This material, buried deep in the ground and long forgotten, was the source of the curious "acid mine" the tunnel men had struck. By applying dry cement and other alkaline materials through holes in the tunnel, the construction company was able to neutralize the effect of the acid and safeguard the tube.

A dozen floors above ground level in a New York apartment house, another mystery in connection with concrete puzzled construction men until a chemist-detective got busy with his apparatus.

Stains mysteriously appeared on the new ceilings. Then the plaster became porous and began to fall. Replastering did no good. Something in the concrete between the floors of the building was causing the trouble. Laboratory tests revealed that cinders, which had been used instead of gravel in the concrete, contained sulphuric acid salts and these were eating their way through the plaster. The owners of the building removed the plaster and placed a protective coating of shellac and alkali between it and the concrete. Now before cinders are mixed into concrete, they are carefully leached with alkali water to remove the harmful acids.

In another instance, a tip from an industrial chemist solved a Manhattan building mystery and saved a large sum for a contractor. In completing buildings, he was using a certain kind of plaster and finishing coat. The plaster, he found, absorbed water like a sponge, sucking it in so fast the finishing coat was dry before workmen could smooth it out. The chemist tackled the problem and discovered that by adding only two thousandths of one percent of common laundry soap in mixing the plaster he could make the trouble disappear. The soap reduced the porosity of the mixture. Although the plaster absorbed as much water in the end, it did it more slowly and workmen could smooth out the finishing coat before it dried.

On the other side of the continent, in Los Angeles, Calif., customers of a manufacturer of prepared flour were complaining that the flour quickly became rancid. Samples of the flour were taken to Prof. Arthur R. Maas, Los Angeles consulting chemist and were there analyzed.

Maas smelled the rancid product. He tested the individual ingredients—powdered milk, flour, baking soda, salt, shortening. Each seemed of finest quality.

Then investigating further, Maas found traces of copper in the milk and from this clue solved the mystery. When the ingredients were mixed, the copper particles, being a catalytic agent, slowly oxidized the fats in the shortening. A catalyst is a substance that by its mere presence causes other chemicals to react without itself actually taking part in the reaction. Thus the presence of the copper in the preparation had caused thousands of packages of the prepared flour to become unfit for consumption.

The copper, Maas found, was entering the milk from kettles and the elimination of the kettles ended the trouble.

A Boston, Mass., restaurant for years, had featured a certain kind of bun which was baked in Philadelphia, Pa. The proprietor of the restaurant hired the baker to come and make the buns in Boston. He continued to use exactly the same ingredients but customers complained that the buns did not taste the same. The restaurant owner consulted an industrial chemist. His tests disclosed that the altered taste was caused by chemical differences in the water of the two cities.

To avoid a similar possibility, the largest chain of bakers in the country recently adopted the plan of making synthetic water for mixing in the dough. Starting with distilled water, they add so much alkali, so much calcium, so much salt, etc., until they have water "tailored" to standard proportions. This enables them to turn out bread of uniform quality in every part of the country.

In this connection, the secret of why Britishers all over the world send back to England for Bass' ale, swearing no other ale has the same flavor, has just been revealed by the researchers of an industrial chemist. He found that the peculiar flavor of the beverage is due to bacteria in the river Trent, which supplies the water used in making the ale.

On the other hand, chemical tests have upset the belief that Roquefort cheese owes its taste to the locality in which it is produced. This blue-mold cheese, famous since the days of the Romans, ages in the caves and grottoes beneath the village of Roquefort, in southern France. The caves were believed to impart the flavor until late tests showed that by use of the same bacteria and by temperature control, identical cheese could be produced in other parts of the world.

Not long ago, an eastern manufacturer of cleaning fluids found himself with a problem on his hands. A colorless preparation put up in glass bottles remained unchanged as long as it was on store shelves. But when placed on display in the window, it gradually turned to a lemon yellow. Factory chemists turned ultra-violet rays on a sample of the liquid, but its color did not change. Then they sealed it in a bottle and *(Continued on page 117)*

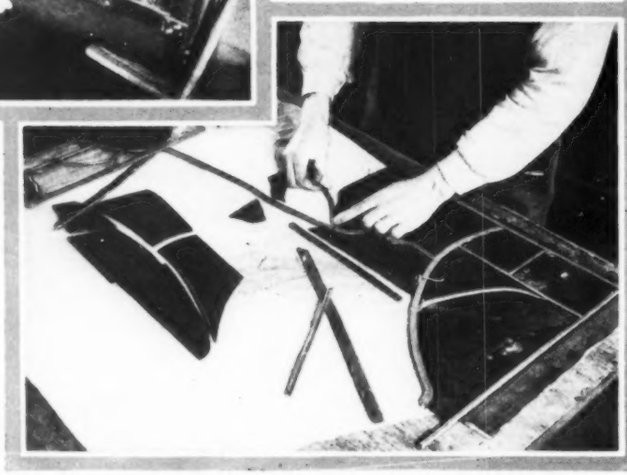
New Stained Glass, Made by Old Methods, Rivals World's Best

CHANGED but little by the age of machinery and skyscrapers, the ancient craft of making stained-glass windows is still being carried on. Photographs on this page show how artisans of the little town of Treptow, near Berlin, Germany, produce windows rivaling those of the medieval masters. The modern technique resembles the ancient one and consists, first, of a pattern, prepared from a preliminary drawing, which serves as a guide in cutting the hundreds of pieces of colored glass. To accentuate lines and shadows, enamel and paint are applied to these pieces and they are then baked to fix the color. Pieced together like the parts of a jig-saw puzzle, they are joined with lead strips, and a few dett touches with an artist's brush bring out the final detail.

1 In the making of a stained-glass window, the initial step is to prepare a rough preliminary drawing. This is a guide in making the final patterns by which the pieces of glass are cut and placed

This window, in which the figure of a bishop appears, is a typical example of modern stained-glass creations rivaling famous examples of medieval work

2 With the patterns made from the working drawing, these artisans are cutting pieces of glass from sheets of various colors. Shadows are painted and lines enameled in



3 The pieces of glass are fired, as above, to fix the paint and enamel. In most cases it is necessary to color and refire a piece often to get the effect desired

4 At right, a craftsman is joining the finished pieces by means of calms, or lead strips shaped in section like the letter H. When the edges are pressed in, the glass is held firmly

5 Even after the glass is assembled into a complete window, an artist goes over it critically, touching it up with the brush to bring out detail. Above, a painter is putting the finishing touches on a cherub

Solving the Secrets of Rain

This gage records the intensity of the rain in every 15-minute period of a rainstorm

One of the six dams used to impound water and eroded soil from the watersheds of the experimental forest. The houses protect the delicate instruments which record data used in research work

HOW can more mountain rainfall be made available to cities and to fertile but arid deserts? How can this be done without washing away the valuable and irreplaceable soil of the highlands? What type of vegetation will best protect the soil against excessive erosion?

Exact answers to these important and perplexing problems of irrigation and water supply are being sought by the Forest Service of the U. S. Department of Agriculture in one of the world's biggest laboratories. This vast outdoor research plant covers 17,000 acres.

The laboratory consists of two tracts in the San Dimas Experimental Forest located in the mountains near Glendora, Calif. Networks of ridges in these areas form six natural watersheds. These are as unlike each other as can be imagined. Some are small in extent; others cover hundreds of acres. Some are rocky and bare; others are covered by the brush common to southern California mountains. One is so high that most of its moisture is obtained in the form of snow.

The foresters in charge of the work begin their study by measuring the amount of rainfall. For this purpose more than 100 rain gages have been distributed. Some of the gages measure only the quantity of rain but others automatically record its intensity, or the amount falling within a given interval of time.

The next problem is to determine how much of the rain is turned away by the soil. This is done by measuring the amount of water flowing down through the gullies and ravines and then comparing it with the amount indicated as having fallen as rain. Measurement has been simplified by the construction of a dam and reservoir on each of the six chief streams leading from the watersheds. Each dam is equipped with a broad overflow trough, or flume, and with a V-shaped, knife-edged weir to measure with great accuracy the amount of water flowing over it.

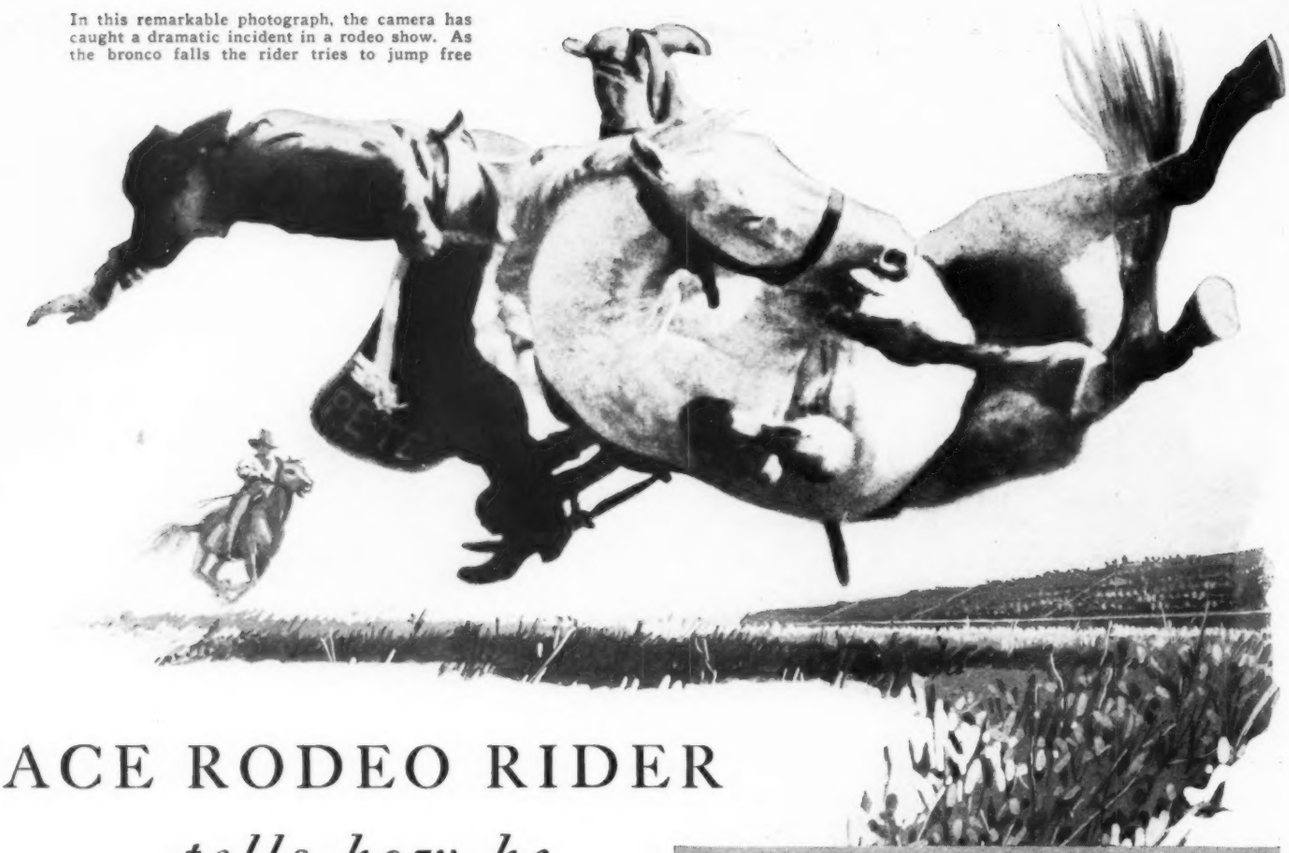
Erosion is calculated with the help of the reservoirs. After rain, the water in each reservoir is siphoned off and the sediment remaining on the bottom is carefully measured. The walls of the reservoirs are marked with vertical and horizontal lines so that this calculation may be made easily. By comparing the amounts of sediment deposited in the several reservoirs, it is possible to ascertain which watreshed has vegetation best suited to bind the soil against erosion.

Close-up of weir, showing notch in which the flow of water is gaged. Fine-ground edges give it accuracy

Nearly 500 rain gages will be installed in the forest to record rainfall at many points

Each of the six reservoirs is marked with contour lines and vertical lines which divide it into cubes. These aid in determining the amount of soil eroded and washed down

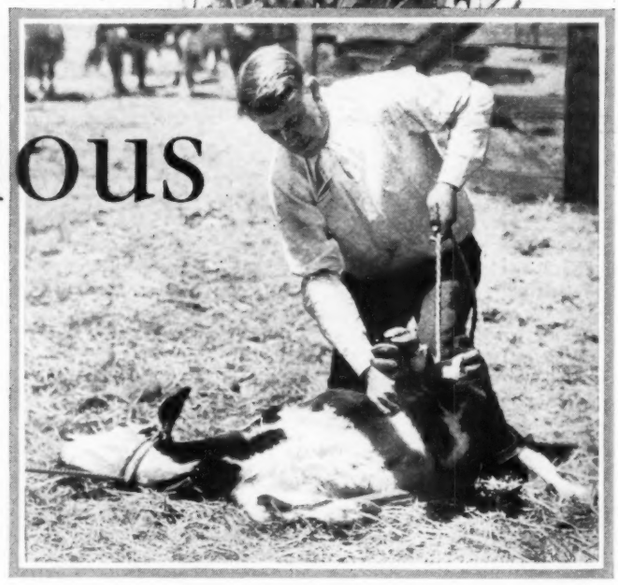
In this remarkable photograph, the camera has caught a dramatic incident in a rodeo show. As the bronco falls the rider tries to jump free



ACE RODEO RIDER

tells how he

Tames Vicious Broncos



The author shows how he ties up a calf. In this contest the riders work against time, and twenty seconds is considered excellent

"COME out scratchin' high, Johnie," the arena director shouted at me, to make his voice carry through the noise of the crowd. "Give 'em a show!"

I eased down on the loosely cinched saddle, placed well back from the bronco's withers, drew in the bucking rein, stuck my feet forward alongside the horse's shoulders ready to spur him into action and as the chute gate opened out we went, me using the spurs and the untamed bronco bucking.

Like a mixture of thunder and lightning he bounded up and away, his head now up, now down, trying with all his strength to dislodge me. For six seconds he continued his plunging, while I waved my hat in the air as though this were only a pleasure ride. Then, as he spun, he caught me off balance. Quicker than you read these words he threw me over his left flank.

As my right foot flew across the saddle, my spur caught in the cantle and there I was, hanging head down among four feet flying faster than greased lightning. What might have happened had I been carried around the arena long in this dangerous position I cannot guess, but the bronco bounded into a gate and as he did so I grabbed a post with both arms and hung on with grim strength. I literally jerked myself loose. The horse, crazy with anger, left behind a much bruised young man, whose hurts included one broken leg, cracked no doubt while he reared and plunged as I hung desperately to the stanchion.

Eight times during my twelve years of riding in possibly 300 rodeos, I have been suspended head down as deadly hoofs flashed within an inch of my head. Every year the cowboys bring out new-fangled ways of sticking on a bronco a fraction of a second longer than was possible the previous season. Seldom does the public see or become aware of the trick; and when officials of the Rodeo Association of America learn them, they change the rules to give the horses a break.

Steamboat, a bigger horse than any now appearing on the circuit, had thrown every cowboy who ever threw a leg over him. This giant range animal from Montana was both mean and powerful, a bad combination. At Merced he tossed Ervie Collins off after three jumps, leaving Collins on the ground with a leg broken in five

Skill and Courage Underlie the Dare-Devil Tricks That Thrill the Spectators at Unusual Show

By JOHNIE SCHNEIDER

The first step in calf roping is to catch your calf. This is done by dropping a small loop over the animal's head, as shown above

places. Then my brother, Frank, drew him. Frank and I stood behind the chutes talking it over a little while before he was scheduled to attempt the impossible.

"What do you think?" I asked.

"Johnie, those fellows have been giving him too much head. I'm going to try a short rein."

Frank grabbed the bucking rein before getting into the saddle. As he slid down into the seat, and found the stirrups, Steamboat trembled with excitement. When the gate opened, Frank pulled the rein back to his right hip, holding it at least four inches shorter than the big fellow ever had been ridden before. The first five jumps I saw him scratching Steamboat's neck with his spurs, then he moved his feet back to scratch along the flanks. And, for the first time in the animal's long career, a man rode him a full ten seconds before leaving his back of his own free will.

Rodeo riders, especially some of the younger fellows, apply science in more ways than one to save their skins and bones without detracting at all from the spine-tingling thrills that the public pays to experience.

For bronco riding the old-timers used to set the saddles way up ahead and cinch them up tight. They thought that in this way the saddles would remain firmly in position. So they did. But some of the newer riders, youngsters still in their teens, began experimenting. They learned that even on rodeo horses saddles not only could be kept on with a fairly loose cinch, but that by shoving them back a few inches they could take advantage of the "give" in the bronco's back as he landed from each buck on all four feet.

WHY RODEO RIDERS WEAR BOOTS AND SPURS

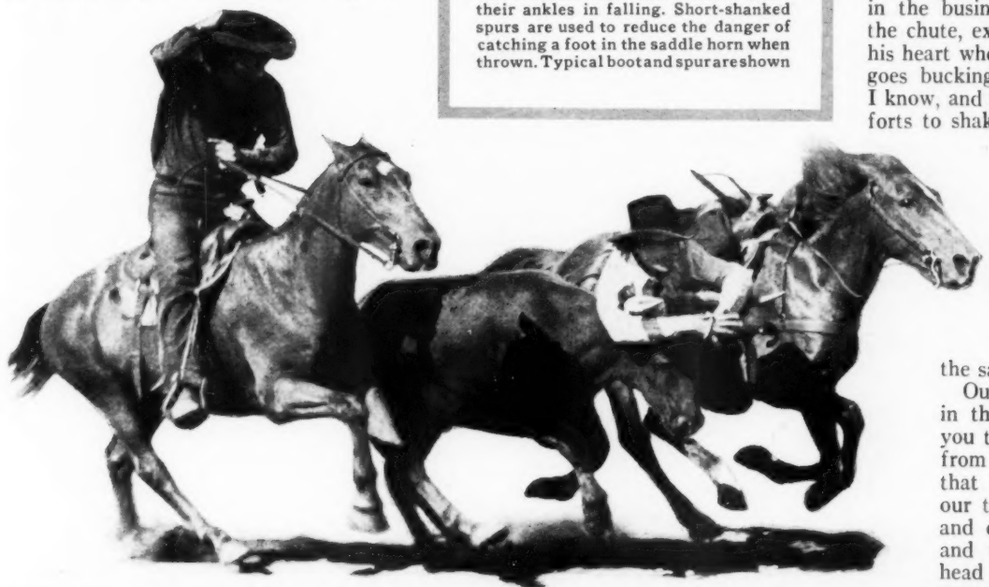
Rodeo riders wear short boots to brace their ankles in falling. Short-shanked spurs are used to reduce the danger of catching a foot in the saddle horn when thrown. Typical boot and spur are shown

There's no particular trick about saddling a bronc in the chute, except to see that the cinch and latigo (strap fastening cinch to saddle) are secure. We don't ride the broncs with bridles. All we get are a halter and one rein leading from the chin strap to one hand. But the way we use that rein makes the difference between riding for one jump or possibly twenty.

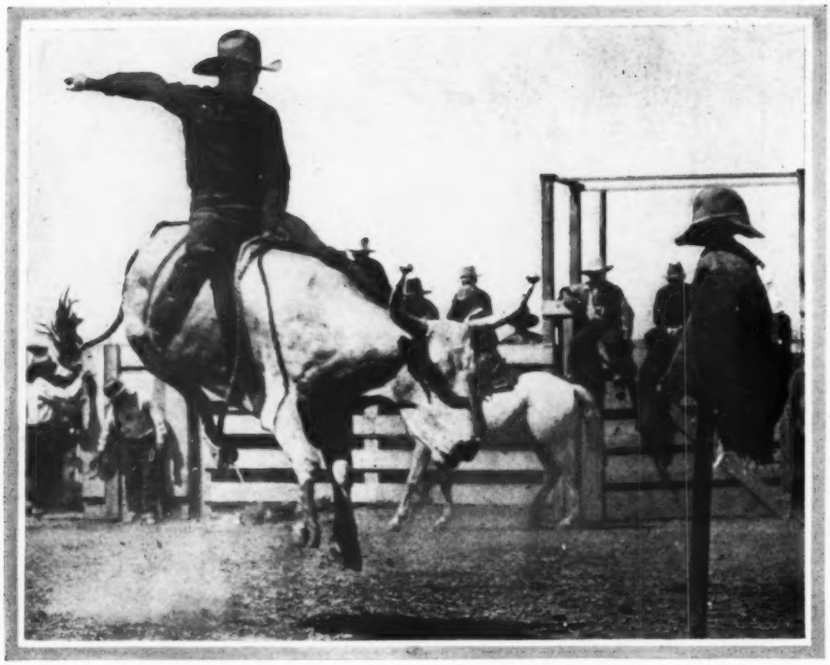
Knowing where to take the rein is two-thirds of the battle. Some large, long-necked horses put their heads down and buck steadily. They require a long rope. Others may have their heads down on one buck, up on the next. These take a shorter rope. C. Y. Jones, a big brown stallion, is one of today's finest buckers and he takes the longest rein of any horse in the business. Though he is gentle in the chute, excitement seems to well up in his heart when the gate opens, and out he goes bucking. He doesn't like a saddle, I know, and that probably explains his efforts to shake all riders off his back.

While C. Y. Jones keeps a steady head, Crying Jew, a mean, no-good horse, represents the opposite type. Most buckers are like him. He throws his head up and down and sideways. When I ride this kind I take a medium rein, holding it close by the saddle horn.

Our aim is, of course, to stay in the saddle ten seconds. When you think that these broncs make from twenty to thirty jumps in that time, you can see we have our troubles, what with no bridle and only a rein tied to a halter, and waving one hand over the head to avoid touching the horse or saddle and being disqualified. Those ten seconds feel like half an hour, and when a fellow falls



A tense moment in the new rodeo sport of "decorating," in which the object is to slip an elastic band over the steer's nose. The "decorator" is leaving his saddle headfirst with both his arms around the horns of the galloping steer, while the "hazer" rides close on the other side to keep it from turning away



Brahma steers, like the one being ridden in this picture, are often more deadly than broncos. Note knobs on the horns to prevent goring

off a tall horse like C. Y. Jones, he falls a long distance and lands on ground that suddenly becomes very, very hard.

Generally a good bucker will throw his rider on the first jump. If I buck off, I usually go on the first or second. This happens so quickly that the first I know I find myself sitting on the earth looking up at flying heels. Oddly, a fall after the first jump doesn't seem to come as hard as a later fall, after the animal is rearing higher and plunging harder, for then my feet are well set and I may drag a foot in a stirrup. The real danger lies in being dragged along the ground and possibly kicked in the head. Or being on the wrong side if the horse falls down, because every bronc fights to get up immediately.

Just to make the ride more interesting, judges eye us critically from the time we prepare to mount until the final signal to dismount, unless the bronco performs that little detail for us. Everything we do counts for or against us.

The rodeo management selects both the riders and horses for each day's events, the management furnishing the horses and we drawing for them by lot. They give us no chance to practice, and if we draw a horse we have already ridden during the contests, we must draw again. We must ride as many horses and as often as the judges decide.

But that isn't all. The rein, made of three- or four-strand braided grass or cotton rope, must be not more than one inch in diameter, without tape or knots, and we cannot wrap it around our hands. One arm must be free—to wave a sombrero in the air. We must not change hands on the rein and the rein hand must show daylight above the horse's neck. Riding rein and hand must be on the same side of the neck. Each rider must leave the chute with both feet in the stirrups and both spurs against the horse's shoulders, scratching ahead for the first five jumps, then high behind the cinch. In the finals, or on the last horse, we are required to ride without chaps to protect our legs. And any of these offenses will disqualify a rider:

Being bucked off.

Coasting with feet against the bronco's shoulders.

Changing hands on the rein.

Wrapping rein around hand.

Losing stirrup.

Pulling leather (grabbing saddle to hold on).

Failure to leave the chute with both spurs against the shoulders.

Not being ready when called.

Using any substance or preparation, such as resin, on our clothing or equipment to help prevent being bucked off.

Although no points toward the national championship are awarded for riding the wild broncos bareback, this is always a thriller. We get no halters for this event. We straddle a bony back in the chute, grab a half-inch rope passed lassolike around the bronco's body and hang on with one hand. Since the wild horses are ridden without halters, they have a free head to toss around as they like. As soon as they stop bucking, which usually comes at the end of ten seconds when we quit spurring, they break into a run and we have to get off as best we can while the horse is dashing at full speed across the arena.

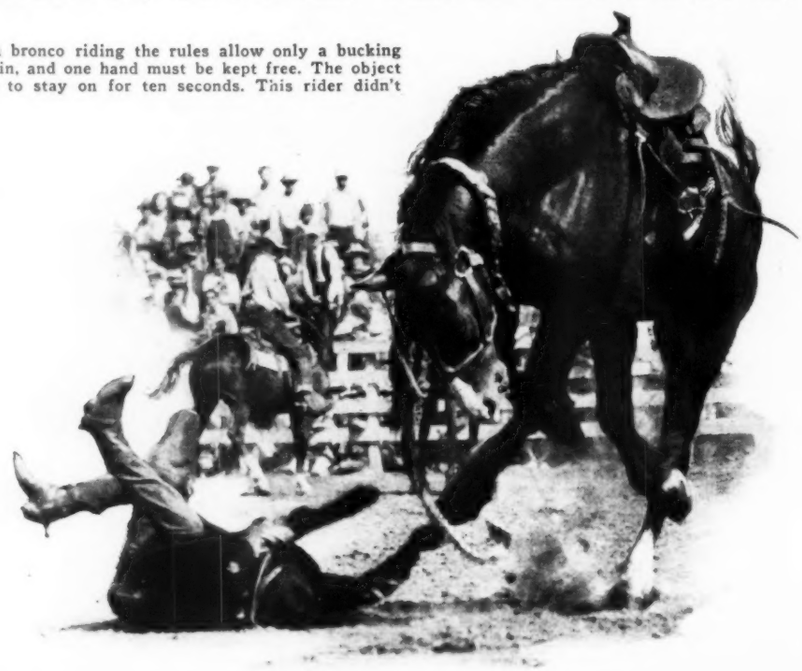
Brahma steer riding is more popular in some states than the bucking broncos, and some of the boys think the steers are more deadly than the horses. These are a mean mixture of India's sacred cattle and Texas longhorns. So mean, in fact, that many of them wear large brass knobs fitted over their sharp horns to protect riders against being gored after being thrown, for the Brahmas nearly always will come back and hook a rider after he's down. Some lie down purposely, then try to hook the rider in the face before attendants can ride up to drive him off. They are so mean they will fight horse or man, and attendants leave them religiously alone in the arena, permitting them to leave on their own accord after they weary of bucking.

Roping calves and steers may not excite the audiences as much as riding untamed horses, but I think it requires greater skill since we work against time. In twenty seconds, or less, a good roper catches the calf, throws a rope over his head, and ties him up.

When it comes to roping the big 900-pound steers, the complexion of the problem alters considerably. We do both single and team roping. In the former we must lasso the steer and turn him around facing the horse without pulling him off his feet. Team roping, though, is a two-man job for fair.

Head man and heeler bust out of the chutes as soon as the steer crosses the dead line. We ride hard until we reach the steer. The head man is first to let fly. He ropes by a half-head or by the neck and turns the steer back toward the chutes. Then *(Continued on page 107)*

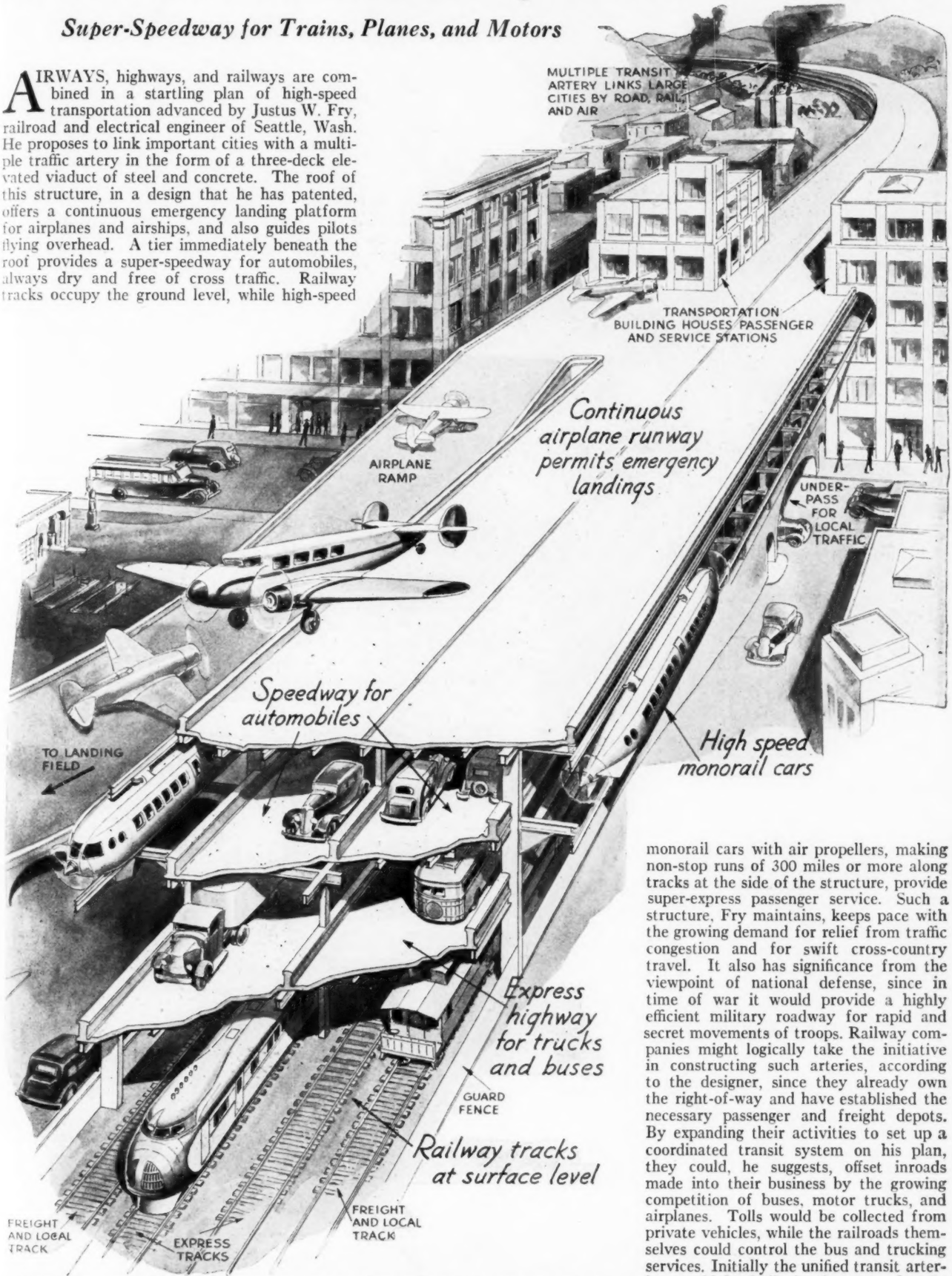
In bronco riding the rules allow only a bucking rein, and one hand must be kept free. The object is to stay on for ten seconds. This rider didn't



Is This the Railway of the Future?

Super-Speedway for Trains, Planes, and Motors

AIRWAYS, highways, and railways are combined in a startling plan of high-speed transportation advanced by Justus W. Fry, railroad and electrical engineer of Seattle, Wash. He proposes to link important cities with a multiple traffic artery in the form of a three-deck elevated viaduct of steel and concrete. The roof of this structure, in a design that he has patented, offers a continuous emergency landing platform for airplanes and airships, and also guides pilots flying overhead. A tier immediately beneath the roof provides a super-speedway for automobiles, always dry and free of cross traffic. Railway tracks occupy the ground level, while high-speed monorail cars with air propellers, making non-stop runs of 300 miles or more along tracks at the side of the structure, provide super-express passenger service. Such a structure, Fry maintains, keeps pace with the growing demand for relief from traffic congestion and for swift cross-country travel. It also has significance from the viewpoint of national defense, since in time of war it would provide a highly efficient military roadway for rapid and secret movements of troops. Railway companies might logically take the initiative in constructing such arteries, according to the designer, since they already own the right-of-way and have established the necessary passenger and freight depots. By expanding their activities to set up a coordinated transit system on his plan, they could, he suggests, offset inroads made into their business by the growing competition of buses, motor trucks, and airplanes. Tolls would be collected from private vehicles, while the railroads themselves could control the bus and trucking services. Initially the unified transit arteries would be built in the most densely populated regions of the country.

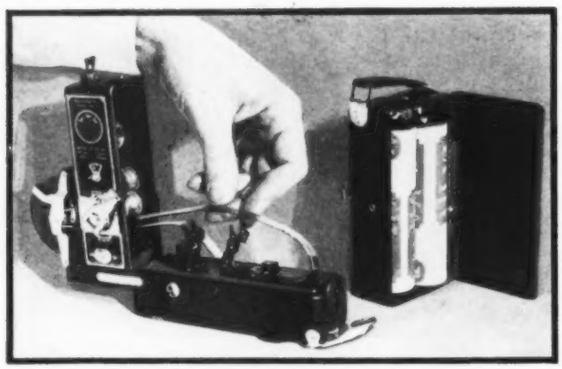

MULTIPLE TRANSIT ARTERY LINKS LARGE CITIES BY ROAD, RAIL AND AIR
TRANSPORTATION BUILDING HOUSES PASSENGER AND SERVICE STATIONS
Continuous airplane runway permits emergency landings
AIRPLANE RAMP
UNDER-PASS FOR LOCAL TRAFFIC
Speedway for automobiles
TO LANDING FIELD
High speed monorail cars
Express highway for trucks and buses
GUARD FENCE
Railway tracks at surface level
FREIGHT AND LOCAL TRACK
EXPRESS TRACKS
FREIGHT AND LOCAL TRACK

This is our artist's conception of the three-decked viaduct designed to carry fast rail and motor traffic between large cities. The roof provides an emergency landing field for aircraft

CHICAGO CHIMES PLAYED FROM NEW YORK

SITTING before a remarkable transmitting device in New York, a musician now plays the chimes in the J. C. Deagan carillon, or bell tower, at the World's Fair in Chicago. The electrical marvel that makes it possible to span the 900 miles between the musician and his instrument is known as the "telemusicon." The operating mechanism is that of the ordinary electric typewriter but to this a new key-board has been added. The key-board consists of twenty-five keys, each corresponding to a bell in the carillon. The electric impulses resulting from depressing these keys in New York are transmitted by wire to Chicago where the corresponding chimes are sounded almost simultaneously with the movement of the keys in New York.

Above, a close-up of the telemusicon that is used by an operator in New York City to play chimes in Chicago. Right, a general view of the instrument which has a key for each bell in the chimes



Above, a loop of film being put in place in the midget movie camera. The film threading is automatic. The battery box with its four cells is also shown. At left, the complete motion picture camera and projector. Flash-light batteries supply power

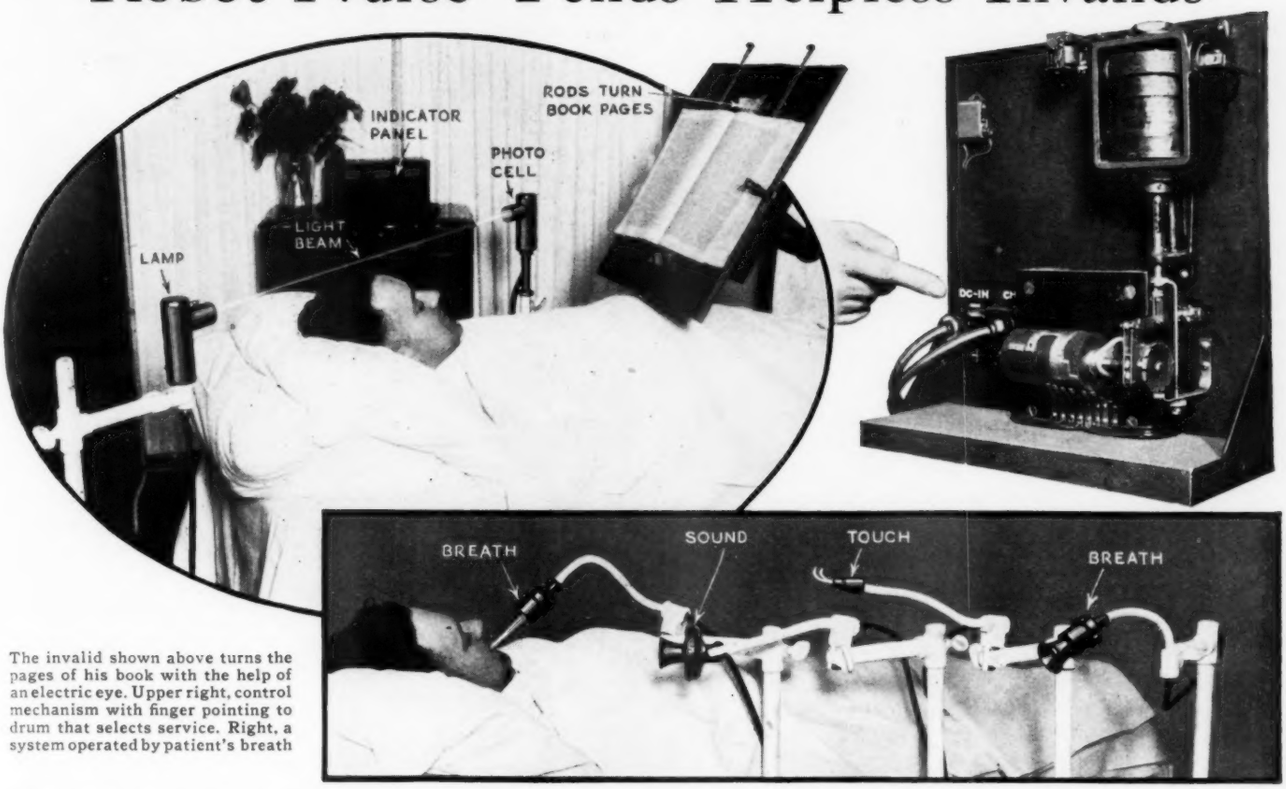
SMALLEST MOVIE OUTFIT THROWS TEN- BY TWELVE-INCH PICTURES

ONE of the smallest movie outfits yet devised has just been introduced in this country from England. The unit is completely self-contained, including a camera and projector and a set of dry-cell batteries. This built-in current supply permits the outfit to be used anywhere. The camera has an extra fast f 2.5 lens and an automatic film-threading arrangement. The lamp built into the set will project clear pictures up to ten by twelve inches. Pictures four feet wide can be projected with an auxiliary base.

MACHINE FILES FINGER PRINTS

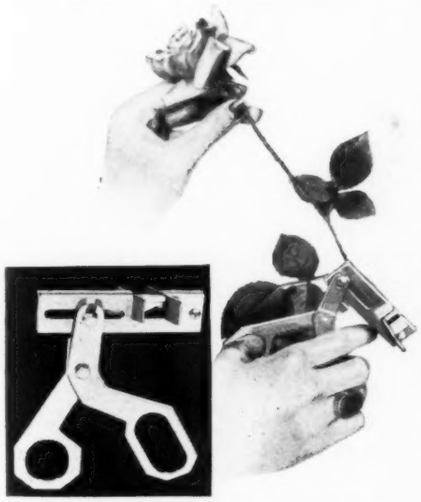
CURIOUS plastic charts resembling huddles of city sky-scrapers are being used by a Berlin scientist to record the result of his long study of finger prints. Characteristics of individual prints, obtained in the usual way by inking the fingers of subjects, are first noted on filing cards. The cards are then classified by automatic machines into special groups according to race, heredity, or other points of similarity. In constructing the charts, the character of the curves, loops, and whirls are translated into figures.

Robot Nurse Tends Helpless Invalids



The invalid shown above turns the pages of his book with the help of an electric eye. Upper right, control mechanism with finger pointing to drum that selects service. Right, a system operated by patient's breath

BY A slight movement of his head, an invalid may turn the pages of a book, operate his radio, put the room lights on or off, and sound a buzzer that summons a nurse, through a new application of the "electric eye" demonstrated recently at the Reconstruction Hospital in New York City. Patients unable to move their hands may thus enjoy a variety of activities without the constant attendance of a nurse. Electric contacts that operate the various devices are all mounted on a single drum that begins revolving when the shadow of the patient's head, falling upon a photo-electric cell, sets the apparatus in action. Meanwhile the words, "Book," "Radio," "Lights," and "Buzzer" flash up in succession upon an illuminated indicator panel. When the name of the desired service appears, the patient withdraws his head, and an automatic relay actuates the chosen appliance, such as wire rods that flip over individual pages of the book. Adaptations of the self-service system for invalids have been developed in which the electric eye is replaced by other ultra-sensitive control devices to suit individual needs. These the patient may operate simply by speaking into a telephone transmitter; by placing his face in contact with a pair of metal electrodes; or by blowing gently into a horn-shaped funnel or a tube resembling a cigarette holder. Thus any type of patient may provide himself with diversion.



CLEAN-CUTTING BLADE KEEPS FLOWERS ALIVE

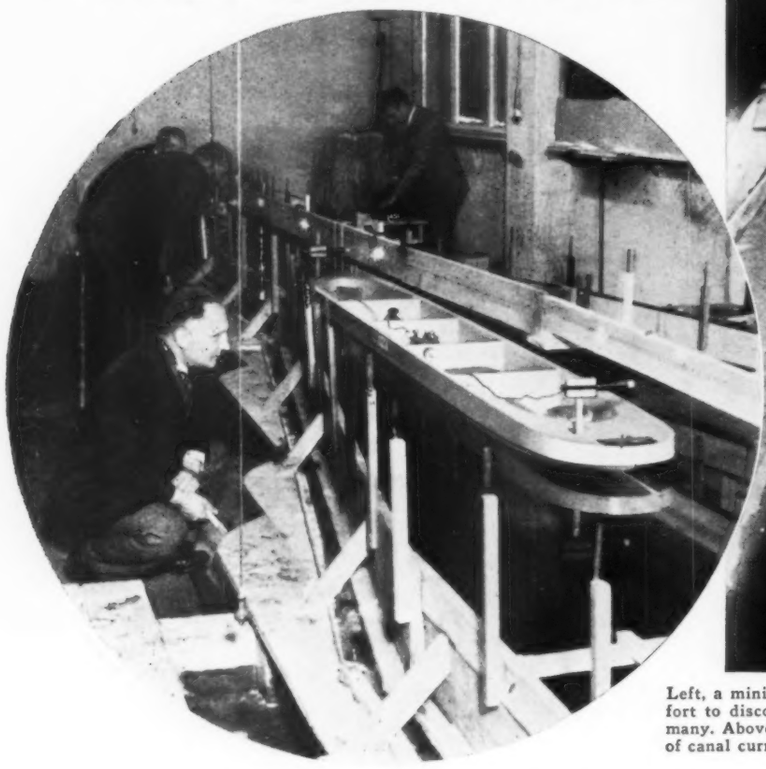
Flowers will keep fresh a long time when cut from the bush with the tool shown above. A razor-thin blade, sliding through a frame, snips the stem off without crushing the cells. The clean cut allows the stem to absorb water readily.

INFLATE LIFE BELT UNDER WATER

A REMARKABLE new life belt that can be inflated under water has just been adopted by beach authorities at an English seaside town. It is inflated by pressing a small rubber bulb, which pumps water into the belt where it combines with carbide to form acetylene gas. Special pylons have been built on the beach to contain the tubes. When the doors of one of these pylons is opened a flag is raised automatically to signal beach guards that a rescue is being attempted and help may be needed.

Above, new life belt that is inflated under water by formation of acetylene gas. Left, one of the pylons in which the belts are stored, showing how flag rises when door is opened

STUDY CANALS IN LABORATORY TO SPEED-UP BARGE TRAFFIC

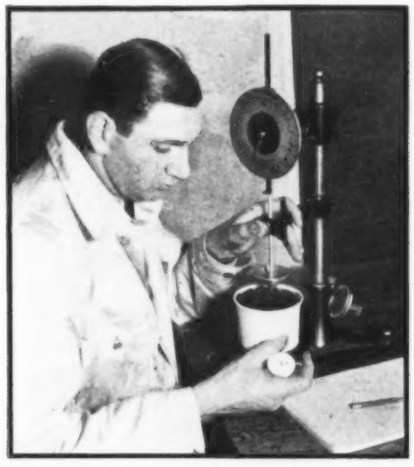


Left, a miniature lock, set up in a laboratory, is being tested in an effort to discover a speedy way of raising barges in the canals of Germany. Above, dropping pieces of paper into a model canal in the study of canal current. The movement of the paper is recorded on photographs

WHOLE systems of miniature canals have been built in a laboratory in Berlin to assist German engineers in their efforts to design swifter canal barges. The behavior of a boat in a canal is dependent to some extent upon the current and this is studied by strewing bits of paper upon the water flowing through the model canals and photographing the paper's actions. Electric bulbs supported above the bow and stern of the model barge enable engineers to make motion pictures of its movements.

CONSISTENCY OF JELLY NOW ACCURATELY GAGED

MAKING jellies and preserves of the right consistency is no longer a matter of guesswork. A device recently developed by the U. S. Department of Agriculture, for use by food manufacturers, determines the exact moment at which boiling has reached the proper point. An aluminum cone, attached to the device, is lowered until it barely touches the surface of the boiling preserves. The distance the cone sinks in five seconds is determined by the stiffness of the jelly and is measured by a needle on a dial.



RUBBER BANDS HOLD CARDS ON OUTDOOR BRIDGE TABLE

PLAYFUL breezes cannot break up a bridge game at the seashore when the game is played on an ingenious new beach table. Numerous rubber straps, fixed to the surface of the table, keep the cards from blowing away. These straps are so placed as to protect the dummy cards, the tricks taken, and the individual cards played. They also hold the cards as they are dealt. The top of the table revolves so that the dummy position can be turned toward any player.

FAT EATERS DON'T TIRE

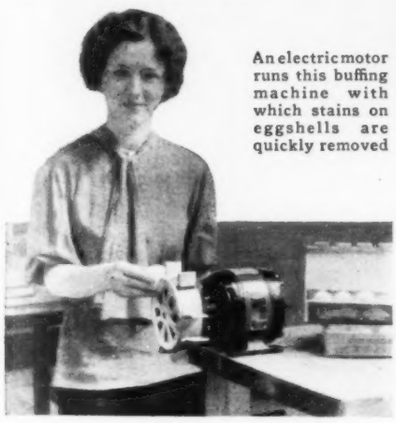
MAN'S resistance to fatigue is in direct proportion to his ability to consume oxygen and fats, Dr. R. B. Dill, of Harvard University told the American Association for the Advancement of Science. He cited dogs as an example.

STEEL BAND HOLDS HAT

SNAPPED into a man's hat in a jiffy, a new metal hanger preserves its shape and permits it to be hung up without denting. A spring band fits the inside of the hat and is compressed by a finger loop, as shown at left, in order to attach or detach the hanger.

NEW BUFFER REMOVES EGGSHELL STAINS

Eggs can be cleaned swiftly and easily, it is said, with a recently devised buffing machine. The buffer is a slotted aluminum cylinder containing rolls of emery cloth. The ends of the cloth pass through the slots and protrude about two inches. When the buffer is rotated at high speed by an electric motor to which it is attached, the abrasive makes short work of stains and discolorations. The buffer, it is claimed also imparts to all eggs cleaned a smooth, dull finish that is popular.



An electric motor runs this buffing machine with which stains on eggshells are quickly removed

This tractor-truck, with rollers to keep it from sinking into mud or sand, will be used by explorer in trip through Canada

TRACTOR-TRUCKS FOR THE FAR NORTH

For a projected 1,100-mile exploring trip from Edmonton, Alberta, to Telegraph Creek, British Columbia, a New York explorer will use a fleet of five tractor-trucks especially adapted for traveling the northern wastes. A large roller affixed to the front springs of each car will prevent the vehicle from sinking in loose earth or mud, and will also aid in climbing over logs and boulders. The trucks will be fitted with skis for use when snow is encountered. In addition, they will carry metal sheets for making temporary roads and rubber pontoons to float them over rivers.

USES BLOWTORCH TO SHAPE STATUES

Using wrought iron instead of marble, and an oxy-acetylene torch instead of a chisel, a California aviator sculptures unusual caricatured figures as ornaments for ash trays and other household novelties. The figures, in lifelike attitudes, are built up bit by bit under the white heat of the small welding torch. The sculptor uses no preliminary drawings, preferring to fashion the figures as the work progresses. After completion, the iron figures are varnished to protect them from the air.

Using a blowtorch figures are shaped of iron by Western sculptor

With the aid of his oxy-acetylene blowtorch, the sculptor is modeling figures of wrought iron in lifelike attitudes

PLANTS GROW FAST IN AIR-TIGHT HOTHOUSE

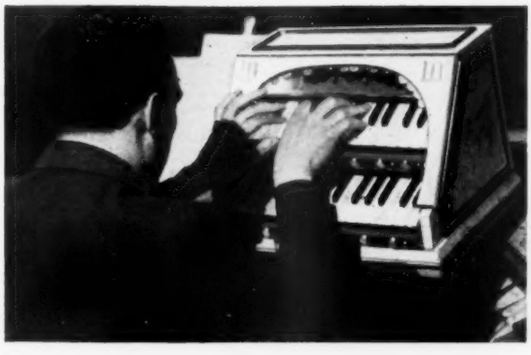
Illustration shows globe in which cacti were grown without contact with air

Will the hothouses of the future be hermetically sealed against air, to speed up the maturing of flowers and garden vegetables? This possibility is suggested by a Russian experimenter who has succeeded in raising small cacti in air-tight containers. His tests indicate that carbon dioxide gas, which plants absorb through their leaves from the atmosphere and use for food, is given off in sufficient quantity by the natural decomposition of the fertile soil. The plants thrived within the globe and assumed a luster unknown in the natural state.

MECHANICAL WONDERLAND AGAIN AT WORLD'S FAIR

The exhibition of scientific wonders comprising Popular Science Monthly's Mechanical Wonderland is being shown again this summer at the Chicago World's Fair. Those who saw the display last year as well as those who did not see it then are invited to visit it in General Exhibits Building One, next to the Hall of Science.

MIDGET CONSOLE FITS BIG PIPE ORGAN



Musical effects never before heard on a pipe organ can be produced by means of a midget console just devised by a Boston musician and used by him to play one of the largest pipe organs in existence. The new console has only fifty-eight keys instead of the 183 usual on a big organ, but its numerous electric switches enable the organist to play any note or combination of notes of which the regular console with its many keys is capable.

HUNTING Fireballs THAT FALL TO EARTH

By FRANK CLAY CROSS

AT 9:20 o'clock on the evening of February 12, 1934, a brilliant fireball appeared suddenly in the heavens over west-central Idaho. It moved swiftly toward the east, across Wyoming, across Nebraska, almost to the boundary of Iowa. As it neared the middle of its course it exploded like a giant skyrocket, and thereafter three fireballs, instead of one, were seen, traveling in formation like a trio of airplanes. The brilliancy faded, too, and became a dull glow. Few meteors have ever presented so strange an appearance, and few indeed have been seen in flight over so long a course, a course of almost 1,000 miles.

Hardly had the fireballs vanished before telegraph wires, all through the West and Middle West, began to hum with an account of the phenomenon. It was news—news that would excite comment over scores of breakfast tables and then be forgotten. For one man, however, it held far more than transient interest. That man was H. H. Nininger, curator of meteorites in the Colorado Museum of Natural History in Denver, and the world's greatest hunter of the queer projectiles that sometimes hurtle down upon our planet from the sky. He knew that those three fireballs were masses of stone or iron, glowing with the heat of friction as they sped through our atmosphere, and that somewhere, probably on the plains of eastern Nebraska or western Iowa, they had plunged to earth. He must find them, for perhaps they would shed new light on the mysteries of space.

Nininger had mapped the trails of many meteors from the points where they first appeared to the points where they vanished. He knew, therefore, that the first step was to get in touch with persons who had seen the flight of February 12. One of the unique features of meteoritics is that it is dependent on the observations of laymen, of those who chance to see it speed across the sky, or who accidentally come upon one of its pieces after it has come to earth. Therefore, the men who study meteors and meteorites want to spread knowledge about

Right, Prof. H. H. Nininger, curator of meteorites in the Colorado Museum of Natural History, plotting the path of meteor that fell in February

Above, only photograph ever taken of a flaming meteor rushing to earth. The picture was made near Wagon Mound, New Mexico, in March, 1933, by an amateur astronomer

By nailing a stick to a tree and sighting along it, it is easy to see and record meteor's angle above horizon

them, so that everybody may know just what to look for and how to find it.

The Denver meteorite hunter gave a story to the newspapers, in which he requested that every observer of the meteor should write to him at once, and answer these specific questions: Where had the writer been when he saw it? Where in the sky had it first appeared to him and where was it when it disappeared? How large had it seemed to be? Had he seen or heard any explosions? Was there any other noise as the meteor sped along?

The newspaper stories brought dozens of replies, and many of them inconsistent. A writer in Billings, Mont., said that the fireball passed directly over that city. Another in Salt Lake City, 350 miles south, said it passed over northern Utah. Farther to the east, a third writer in Hot Springs, S. D., was positive that the lights, then three in number, had sped across the sky right above him. From far down in Johnstown, Colo., another submitted precisely the same report.

Obviously, if the meteor had traveled from west to east, it was utterly impossible for it to have passed directly above points so far apart, north and south; but Nininger was not at all perplexed by these conflicting reports. He had learned, long before, that most men and women are poor observers. His next step was to call personally on a chosen number of the letter-writers who had seen the meteor.

The man in Hot Springs was at first equally positive on personal interrogation that the meteor had gone directly over him in its path across the sky.

"Do you mean it went exactly over the spot where you were standing?" asked Nininger who, of course, was doubtful.

"Well, no," the man answered. "It went

Amateur Observers Can Aid Science by Careful Observation of Flaming Meteorites—Check the Elevation and Position by Star Constellations

over the south end of town, about a half mile, I should say, from my home here. I was out in the yard when I saw it."

That immediately solved the problem. This man had unconsciously estimated the altitude of the fireballs at a few hundred feet. Actually the missiles had been about forty miles above the earth, which made his report indicate that they had passed perhaps from thirty to forty miles south of him. His notion that they had been only about a half mile south was simply an optical illusion based on his ignorance of their actual altitude, their speed, and their size.

STAR MAP FOR METEOR STUDY

By means of a star map, made as previously described in this magazine, (P.S.M., June, '33, p. 42), one who is lucky enough to observe a fireball in motion across the sky, can chart its course with great accuracy, as is being done in the illustration shown above

Persons unacquainted with the character of meteors almost invariably think that the fireballs are vastly closer to the earth than they really are. When they first appear, they are likely to be sixty or seventy miles high, or even higher, and the light fades into invisibility while the meteor is still from six to twenty miles up. This disappearance is easy to explain. The stones enter our atmosphere at enormous speeds, ranging from about eight miles to about forty-five miles per second, depending on whether they collide with our earth head-on, or overtake it from behind as they sweep out of space.

This speed, which heats each missile to incandescence, is rapidly reduced, however, as the mass descends into the lower and denser atmosphere. It is like a rock thrown into a deep pool of water. As the speed is retarded, the friction of the air grows less intense, and consequently the missile cools. If a stone happens to be extremely large, it may still be very hot when it reaches the ground; but the smaller stones, which are vastly more common, may be picked up in the hand immediately without real discomfort.

Another queer vagary of observers without experience comes to light when they try to describe the size of a meteor. One farmer, near Scottsbluff, Nebr., reported that the fireballs of February 12 looked as large as washtubs. Another, on an adjacent farm, reported that they looked about as big as cherries. A washtub how far from the eyes? A cherry how far from the eyes? They completely ignored the fact that a cherry a few inches away looks larger than a washtub 200 yards away.

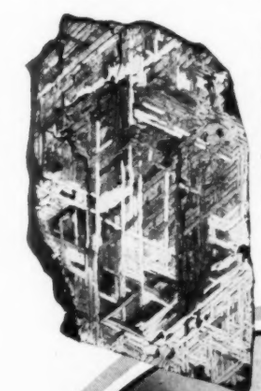
The only intelligent way to describe the apparent size of a meteor is to compare it with a large star or the full moon. In actual size a fireball may be as much as several miles in diameter. This brilliant sphere of light, however, is not the projectile itself, but the hot gasses which surround it. The real meteorite may possibly be no larger than a football.

These three reports, given by the farmers near Scottsbluff and the man in Hot Springs, were models of scientific accuracy when compared with several others that came to Nininger, in the course of the same investigation. Probably the prize of the lot came from a grocer in Tilford, S. D. This man had decided that the trio of meteors were, in fact, all one huge stone with one headlight and two tail-lights.

"The headlight was very bright," he wrote, "and the rear lights must have resulted from thick bulges in the meteor, which was over seven miles long and one and one-half miles in thickness. It might have been a mile or two longer, but tapered off at the rear without any bulge to make air pressure for another light.

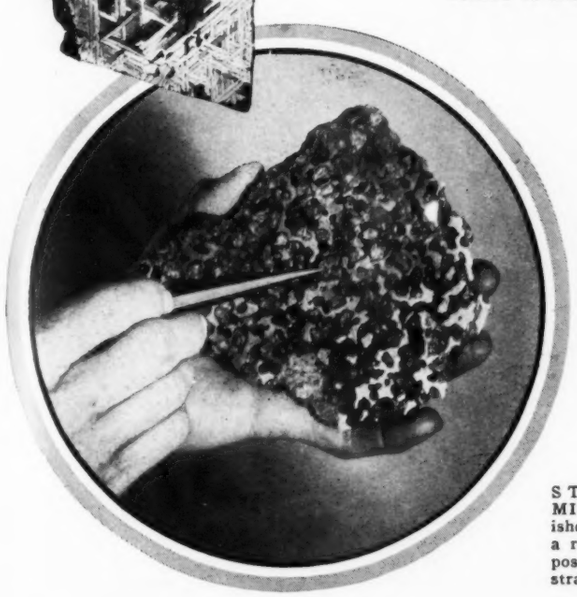
"It is almost a positive fact," he went on to say, "that the meteor returned into space, for gravity is too low for the meteor's velocity. It is my opinion that it was the same meteor which was seen on July 20th, 1860, just loafing along in the earth's orbit around the sun."

Of course no meteorite ever returns into space after it has entered the earth's atmosphere; and if a stone as much as seven miles long were to fall in eastern Nebraska, where the projectile of February 12 actually did land, it would completely devastate the cities of Omaha and Lincoln. The hurricane blast of hot air would sear the country for hundreds of miles around, *(Continued on page 106)*



LINES IN IRON METEOR

When a fragment of an iron meteorite is polished and treated with acid, lines appear as seen at left. They are found only in fragments of meteors



STONE AND IRON MIXED. In circle is a polished bit of pallasite. This is a rare type of meteor composed of stone and iron strangely blended together

· Freak Hazards Met by

Perched high above the ground, a telephone trouble man sorts out the strands in a broken cable and joins them together. Lead sheathing now makes such breaks infrequent

Mysterious Things That Silence Phones and Turn Linemen into Detectives Are Explained in This Article—Tiny Animals Also Interrupt Service

By ROBERT E. MARTIN

ALL over a community in New Jersey, telephones were ringing mysteriously at odd hours of the day and night. When answered, the only reply was crackles and crashes. Between times, the instruments functioned perfectly.

Trouble men combed the lines looking for the secret of the mystery. Finally one of them climbed a pole in a wooded section to examine a junction box forty feet from the ground. As he swung open the door, out shot a chattering gray squirrel. Inside young ones were curled in a nest lined with insulation chewed from the wires. In moving about, the squirrel had caused the bare wires to touch from time to time, producing the short circuits which rang the bells and made the noises.

Such curious discoveries are all in the day's work for a telephone trouble man. The unexpected looms large on his schedule. In keeping open the tens of thousands of miles of electric wire which crisscross the map and form channels of communication, he wages war against ants, tornadoes, earthquakes, beetles, ice storms, woodpeckers, log jams, bird shot, spider's webs, salt fogs, and even, strange as it sounds, gamefish.

In New Hampshire, for instance, a nineteen-inch pickerel tied up service near Lake Winnepesaukee. Anson McEwen, a trouble shooter working out of Lakeport, N. H., found the pickerel twisted in the wires thirty-five feet in the air. How did it get there? McEwen's guess is that a fish hawk or eagle dropped it when attacked by another bird.

On the other side of the continent, in Washington, an eagle recently got into difficulties which resulted in a hurry-up call for the trouble men. It landed on top of a telephone pole to eat a young rabbit. When finished, it spread its huge wings for flight and on the first downward stroke the tips struck two wires. The result: a short circuit which played havoc with the lines and interrupted the service.

In Colorado, crows have kept telephone men on the jump. Where the Denver-Lamar line crosses a lonely section of country without trees or brush, the birds have been building their nests in the crossarms of the poles, using bits of wire for the foundations. In a space of twelve days, these rusty bits of barbed and baling wire resulted in twenty-five short circuits. During the nesting season, three linemen are kept busy removing the metal from the poles.

In one instance, two of the men started from points fifty miles apart and worked toward each other removing the nests as they went. When they met, one had cleared away thirty-two masses of wire, the other thirty. Then, when they made a test of the circuits, they discovered there was trouble back of each man. The crows had already placed new pieces of metal in the crossarms.

Each section of the world, it appears, has its own problems for the hard-working trouble spotter.

In Brazil, for example, there is a spider which spins huge webs among the wires. They are harmless as long as the weather is fair. But when a driving rainstorm beats them into long wet strings that reach the

An eagle, rising from the top of a telephone pole, beat the wires with its wings and caused a short-circuit that interrupted the service

A flood threatened to sweep a pole and its attached wires down stream so a lineman got a rifle and shot off the insulators on the cross arm, freeing the wires

Telephone Trouble Men

ground, they cause current leaks and serious tie-ups. In wooded country, wet tree-branches, rubbing against wires, sometimes bring about the same results, causing much trouble.

In Africa, giraffes cause trouble by rubbing their chins on the wires or by running into them and snapping them in two. In another part of the same continent, only metal poles can be used because termites will quickly reduce wooden supports to heaps of useless sawdust.

Tiny plants, that attack wood cells in poles and cause them to rot, have been given special study in Germany. Scientists have evolved a curious process for killing them. By using penetrating hammers which resemble huge hypodermic needles, they inject a preservative paste into the poles around the base. Similar treatments are now being tried in the United States.

In the far northwest, another enemy of the telephone pole is a little white-headed woodpecker that considers dry cedar a special treat. It drills holes in the soft wood and the weakened poles fall unless frequently replaced.

Cutting his teeth on the telephone cord, a baby put a phone out of use

Swinging on the wires in the basement, in which he lived, a monkey made the phone in a private residence unusually noisy until a trouble man stopped him

Where the transcontinental telephone line crosses the desert west of the Great Salt Lake, in Utah, a strange apparatus which looks like an old-fashioned fire engine travels back and forth fighting an enemy peculiar to the locality. It is the salt fog.

These heavy fogs, depositing large quantities of alkali on the glass insulators, cause a serious loss of current. Unless they are removed, conversation over the lines becomes muffled and in time practically inaudible.

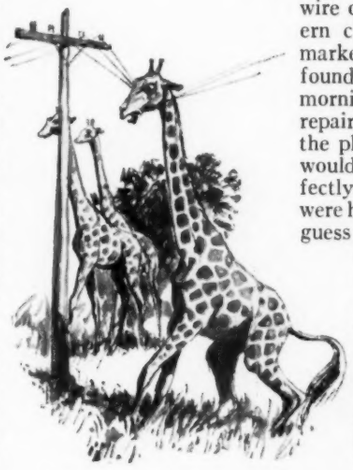
So now, men ride across the desert regularly, towing a specially designed steam boiler. At each pole, through pipes resembling fishing poles, they squirt jets of live steam around the insulators to clear away the alkali deposits. Such washings eliminate about ninety percent of the current loss due to the alkali.

West of the desert, in Nevada, there is another odd problem for trouble men. Here the transcontinental line stretches straight across the shallow water of Humboldt Lake, the poles being set in the muddy bottom.

A few years ago, during a northwest gale, ice floes crashed into the poles. A mile of wire went down. Working up to their waists in icy water, a crew battled for four days to restore service. The wind at times reached seventy miles an hour and the men worked in twenty-minute shifts, thawing out around huge fires between times.

Heat and cold often add to the troubles of the repair man. In hot weather, for instance, the metal wires expand and sometimes sag so low it becomes necessary to cut out slack to prevent them from swinging together and becoming crossed. Then a sudden cold snap contracts the wires and they break.

Humming wires sounded like bees to a bear so he climbed a pole to investigate. He found no honey but he smashed insulators



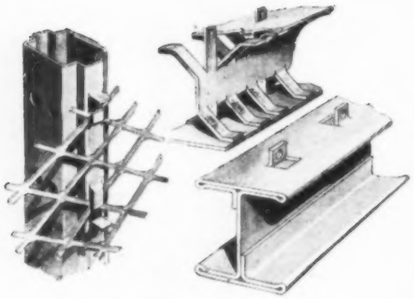
In Africa wild giraffes run into phone wires and snap them

A curious case involving the effect of heat upon a telephone wire occurred in an eastern city. At a produce market, the phone was found out of order each morning. But before a repair car could reach the place the instrument would be working perfectly. Trouble shooters were helpless until a lucky guess solved the mystery. Uncovering the wires, they found a broken strand within the insulated cord that ran close to a stove. During the night, the wire contracted pulling the broken ends apart. Then each morning as the stove heated up, the metal expanded and closed the gap.

Just as puzzling for a time was another case which turned up last fall in a western city. The telephone in a doctor's office would go dead suddenly; then, a few seconds later, it would function again. The cause was traced to a window shutter which swung back and forth. Each time it opened, it put a strain on a broken wire inside an insulated cable and pulled the ends apart.

In another instance, failure of telephone service was traced to the handkerchiefs the stenographers washed during the noon hour and hung to dry on a telephone cord between two desks. The moisture, entering the cord, caused a short circuit. After rainstorms, wet umbrellas sometimes produce similar difficulties. But the queerest incident of the kind is reported from Chicago, Ill. Answering a call to a private residence, a *(Continued on page 120)*

A sleet storm in Tennessee snapped this cable and when repair men arrived they found that the cable could be reached only in a boat. Wearing life preservers they tackled the job



REMARKABLE NEW GIRDER SAVES TIME AND LABOR

A ONE-PIECE structural beam, combining unusual lightness and strength, is the latest thing produced by Ethan I. Dodds, of Central Valley, N. Y., who has been called the world's most prolific inventor. Clips that are integral with the beam provide a labor-saving means of attaching lath and reinforcing wire, and this feature is expected to lead to new departures in methods of constructing houses and buildings, as well as concrete tanks, silos, and culverts. A few of the various forms that Dodds has developed for these purposes are shown in the illustration. The patent covering the beam is the 2,036th that he has been granted in the course of his inventive career.

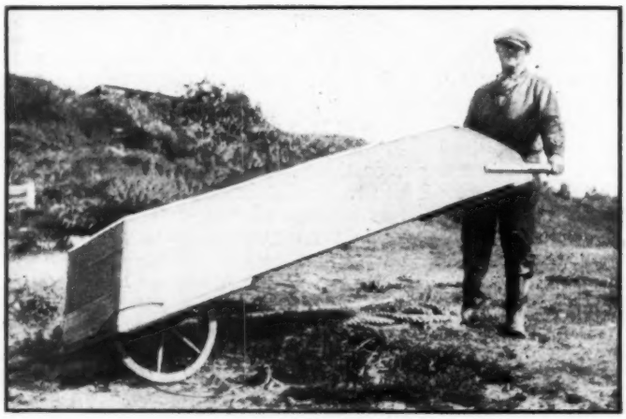
WHEELBARROW BOAT NOW USED BY FISHERMEN

CONVERTIBLE into actual wheelbarrows are the skiffs used by Maine fishermen to row to and from the power boats anchored offshore. In a style developed at Crescent Beach, Maine, a small wheel is set into a recess under the bow of the skiff. By means of handles bolted to the gunwhales at the stern, it can be rolled across the beach. Another type has a big wheel placed inside the skiff, which is turned over in order to wheel it.

HALF-MOON GLIDER FLOWN IN RUSSIA

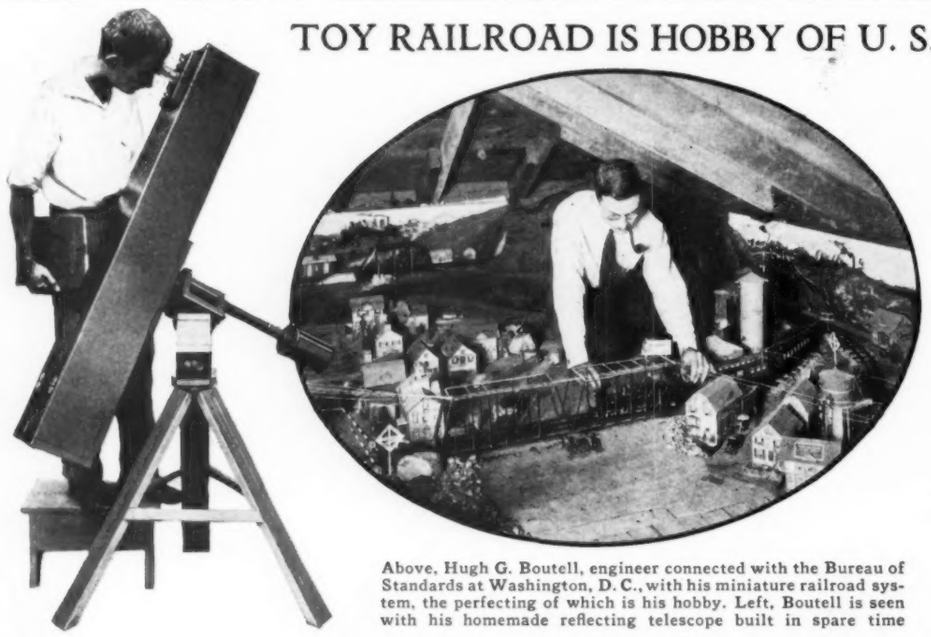
BREAKING new ground in glider design, a tailless half-moon glider has been flown successfully in tests conducted near the Crimean town of Koktebel in Russia. The glider consists of a single semi-circular wing. This wing is thick, curved at the front edge, and tapers off to a thin, straight trailing edge. Ailerons are affixed to the trailing edge but, contrary to usual glider and airplane practice, they extend the entire width of the wing. The pilot sits in a partially covered cockpit in the middle of the wing. The unusual glider will be given further tests at Koktebel where glider activities of the Soviet are now centered.

Glider, with one wing, which is shaped like a half-moon, has been flown successfully



Maine fishermen have added a wheel to their skiffs so that they can be pushed across the beach much as a wheelbarrow is propelled. The one at left is inverted when it runs on its wheel

TOY RAILROAD IS HOBBY OF U. S. OFFICIAL

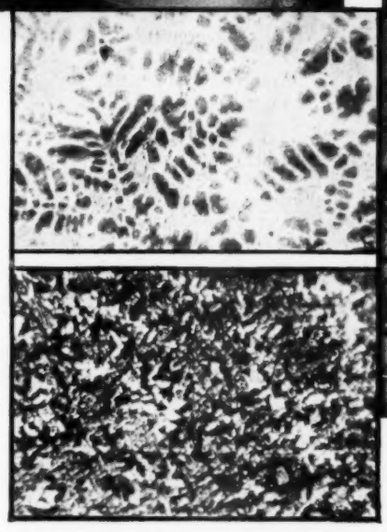


Above, Hugh G. Boutell, engineer connected with the Bureau of Standards at Washington, D. C., with his miniature railroad system, the perfecting of which is his hobby. Left, Boutell is seen with his homemade reflecting telescope built in spare time

THE grandfather of Hugh G. Boutell was president of a railroad company and now Boutell owns a whole system, but with a difference. Boutell's system is housed in his attic in Washington, D. C., where Boutell, an engineer, is in charge of the Bureau of Standards' public information section. His railroad system serves a toy community, pierces papier mache mountains, bridges imaginary rivers, and operates crossing gates, all made by Boutell. Depots, roundhouse, and shops make the model system complete.

Camera Reveals Counterfeit Money

Money, suspected of being counterfeit, is photographed with the metallograph, as above. This gives an enormously enlarged view of a section of the coin and reveals the nature of the alloy



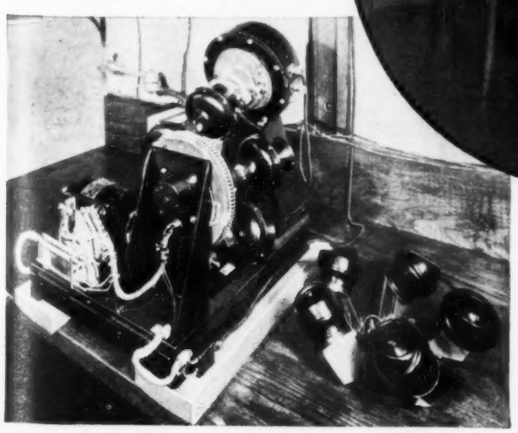
In oval, counterfeit money seized by government. Above, cataloging fake money before studying it. Left, upper view shows honest money; bottom view, fake product

BY STUDYING with latest scientific equipment the methods used by German counterfeiters, chemists and metallurgists in the Prussian State Mint learn the secrets of the illicit craft and are forwarned against clever tricks. Suspected coins are examined for errors in the dies used and, since many alloys used by counterfeiters are lighter than the metals they imitate, the coins are weighed. Analysis of the alloys is made in numerous ways. A device known as a metallograph is used to photograph greatly enlarged sections of the coins in order to reveal the exact granular structure of the metal. If further analysis is found necessary in order to demonstrate the spurious nature of the coins, they are tested in electrolytic baths and melted in electric furnaces.

USE MADE-UP WORDS TO TEST PHONES

NONSENSE syllables, spoken by girl operators into a transmitter, help test the clarity of voice transmission over telephone lines at the Bell Telephone Laboratories in New York. The syllable to be repeated, a random combination of consonants and vowels, is flashed up on a panel before the operator, who repeats it as a part of a simple sentence. Four listeners-in record what they have heard, which may be such a phrase, as "When will *nud* be done?" If the voice is not distorted by line noises, a high percentage of correct guesses as to the unfamiliar word will result, indicating that the hook-up gives satisfactory clarity. The results of the tests are speedily tabulated by automatic instruments, enabling engineers quickly to compare new types of electrical circuits and find the most efficient ones for voice transmission.

Left, panel bearing made-up word and a stock sentence that is repeated into the phone by the operator above. This is done to test clearness of speech over the telephone lines



Left, mechanical mouth that repeats the sound of the made-up word spoken by the operator. Above, listener-in presses keys to show what she has heard

Above, war tank crossing road torn up by explosive as seen in photo at right

EXPLOSIVES WRECK ROADS TO TEST MOBILITY OF WAR TANKS

CONDITIONS resembling actual warfare were created recently by Royal Engineers in order to test the efficiency of British army tanks. Tremendous charges of gelignite and other high explosives were touched off on the proving grounds near Aldershot, England, and huge craters were torn in the ground. The tanks were then sent across the "battlefield" to test their ability to maneuver on ground torn and shattered by shellfire. The roads that were blown up were built of concrete, reenforced concrete, and macadam. The ability of the tanks to cross the debris was carefully noted. The effect of the explosive on the various materials was also made part of the test.

DOG WASHER BOTH SCRUBS AND RINSES

Dog washer, which has soap in its handle, can be used to scrub the animal and then rinse it

A DOG washer, attachable to any household faucet, permits a dog to be scrubbed and rinsed in one operation. The washer is fitted with brush and contains a compartment for soap. Water flows through a hose into the soap compartment and creates a lather. When a lever on the brush top is moved, and the brush is removed, the device is ready for the rinsing.

In this tank, filled with fumes from burning gas, leather samples are aged many years in few months

NEW TESTS AGE LEATHER MANY YEARS IN MONTHS

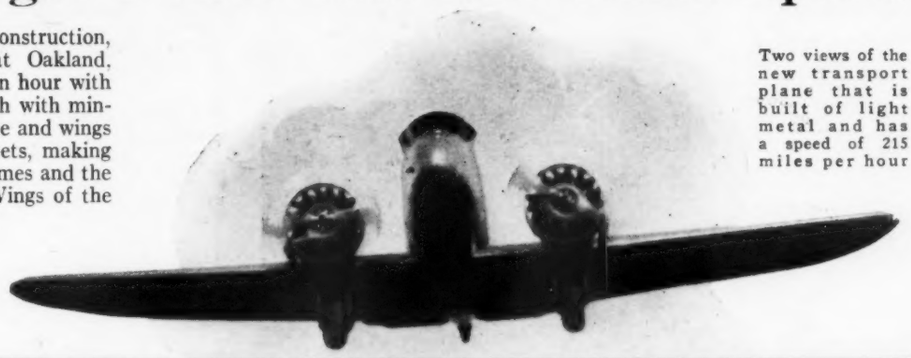
LEATHER is subjected to years of wear in a few months by a method recently developed by experts in the U. S. Bureau of Chemistry and Soils. A cylindrical tank filled with fumes from a gas light is used in the test. Samples of strips of leather, left in the tank for six months, show the signs of age that would be noted after several years of ordinary usage. The deterioration is caused by the sulphur fumes created by the combustion of the illuminating gas.

RAISING NEW FIRE PUMP PUTS IT INTO ACTION

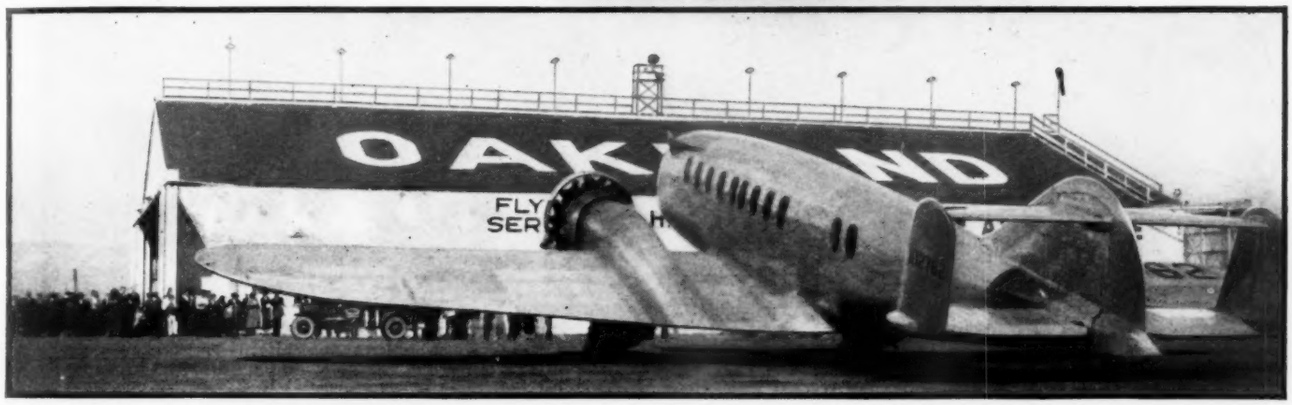
UNDER high pressure, a stream of liquid may be turned on a fire by a new extinguisher that uses a hand pump located outside the cylindrical container. The working parts of the pump, never coming into contact with the liquid, cannot corrode. When needed, the extinguisher is put into action by raising the pump from its normal position alongside the cylinder, as shown above. This movement automatically opens valves and releases the liquid. Lowering it cuts off the flow and closes the valves.

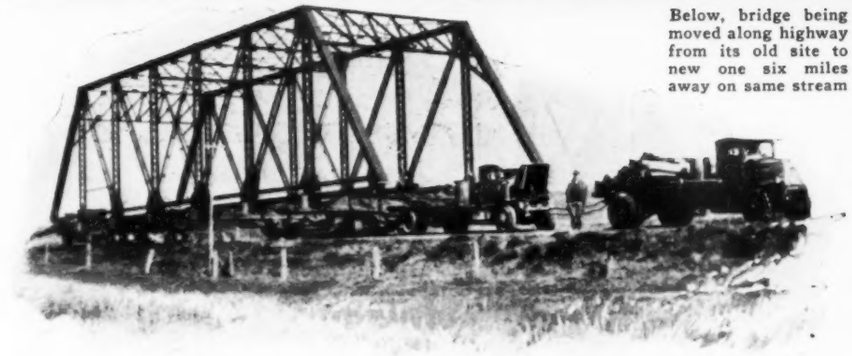
Light Passenger Plane Has 215-Mile Speed

INCORPORATING a new method of construction, a transport plane recently tested at Oakland, Calif., attained a speed of 215 miles an hour with a load of fourteen passengers. Strength with minimum weight is obtained in the fuselage and wings by use of a skin of riveted metal sheets, making possible the use of light transverse frames and the discarding of longitudinal members. Wings of the new plane measure only seventeen inches at their thickest part, compared with twenty-seven inches on regulation planes of the same capacity. Its ailerons can be moved only by the pilot at the controls.



Two views of the new transport plane that is built of light metal and has a speed of 215 miles per hour





Below, bridge being moved along highway from its old site to new one six miles away on same stream

ENTIRE BRIDGE IS MOVED SIX MILES

WHEN a road goes over a bridge it isn't news but when a bridge goes over a highway, as one did the other day near Spokane, Wash., it's an engineering achievement of some importance. The bridge that took the highway journey was moved from a stream at Colfax, Wash., to a new site at Parwin Siding, a distance of six miles.

LOUD SPEAKERS LET BIG CROWD HEAR ADDRESSES

HUGE loudspeakers, resembling street lamps, were used recently to broadcast the voices of speakers at a gathering in Berlin. The loudspeakers, connected by underground wire with a microphone on the speakers' stand, were placed at advantageous points throughout the crowd, enabling several thousand persons to hear the addresses. Cloth coverings protected the speaker mechanism from dust. When set on their supports, the speakers looked like giant lamp shades, as the photo below shows.

USE MICE TO DECORATE HOME NOVELTIES

Both the heads and pelts of carefully prepared mice are used by a New York artist in decorating various household novelties

MICE are used by a New York craftsman in adding decoration to household novelties. The mice are carefully skinned and the pelts cleaned and treated with preservatives. Heads are then stuffed and furnished with beads for eyes. Usually only the head of the mouse is used as a decoration but larger objects call for the entire pelt. Many articles, including bookends, candle sconces, and so on, are being made and decorated in this original manner.

Right, top-stage illuminator in use. The objective here shown is of 16 mm. focus. Below, inserting six-volt bulb in tube of the illuminator. Opening permits the wires to move freely

Right, soldering one of the ears to a top-stage illuminator which is made from an old flash-light reflector

The image of a microscopic object is projected upon the sheet of paper supported above the instrument by a wire stand. This image is helpful in moving the specimen

Using Your Microscope

THERE is no end to the uses to which a microscope can be put. Among other things, it has earned fame for designers, by revealing artistic patterns that can be used in a multitude of ways.

If you were asked, for instance, to devise an unusual design for the cover of a chemistry book, you could turn with confidence to your microscope, and even though you were not an artist, you would find an endless variety of patterns that would serve your purpose. For example, you could place a drop of a supersaturated solution of Epsom salts, photographer's pyro, or some other soluble substance on a glass slide, let it evaporate, photograph the resulting crystalline pattern, and have a design that, for delicacy and beauty, would be hard to beat.

Why not organize a design expedition some evening? Even though you are not particularly interested in producing new patterns for wallpaper, book covers, or printed cloths, you will find it fascinating to uncover with your microscope nature's beautiful art work. You will be treading largely on new ground, for, although flowers and trees and birds and butterflies have been used in decorations for scores of years, relatively few of the microscopic beauties of nature have been thus employed. That the microscope is an able illustrator was proved recently by a booklet dealing with scientific photography. The cover of the booklet was decorated with a reproduction of a photomicrograph of a pine stem, seen in cross section: and it was a very attractive cover.

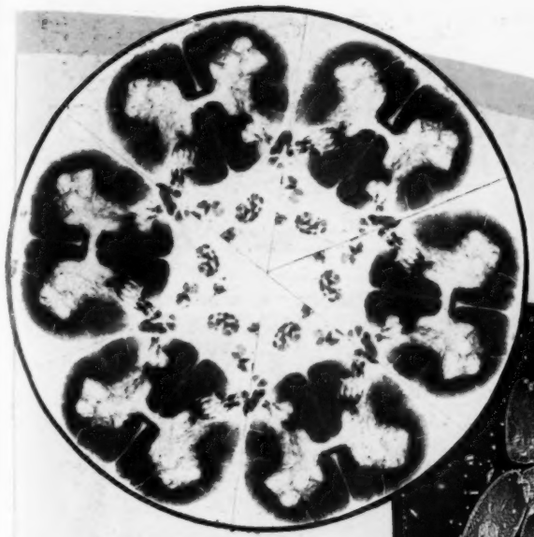
You capture a buzzing insect and find it is a gnat. You can kill it, or any other insect, by putting it into a small bottle, striking a match and thrusting the flaming end into the bottle neck, holding it there a few seconds, and then inserting a cork. The fumes thus produced will kill the insect in a few minutes. With tweezers remove one of the wings and place it on a glass slide, adding a clean cover glass to prevent it from being fanned away. Examine it at fifty or 100 diameters.

You find that the wing is covered with flat scales so pleasingly proportioned that they would lend themselves nicely to decorative uses. A wallpaper pattern, for instance, consisting of insect wing-scale forms, would be modern and attractive. By examining several kinds of insects, you will find that their wing scales differ widely in form and coloring. Wing scales of butterflies and moths are particularly beautiful. Certain beetles produce scales that are of wonderful metallic hues. Scales can be collected separately by shaking the insect in a dry bottle or test tube.

To the microscope, even fish scales can be of great help to the designer. A small area on the side of a sole produces, when enlarged several diameters, a novel design composed of scales that overlap like the shingles on a roof. The same is true of numerous other fish. An individual fish scale, when enlarged to fifty or 100 diameters, may form a geometric design that could be incorporated in modern decorative schemes virtually as it is.

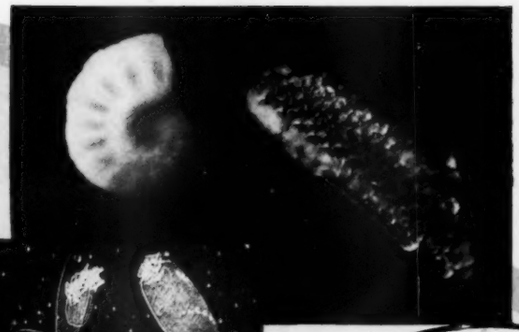
Nature, by combining economy with necessary growth, has produced one of the most pleasing curves known, the so-called spiral of growth or Greek rhythmic curve. (P.S.M., March, '34, p. 58). It is found both in the microscopic world and in normal vision. If you live near a seashore, take a stroll along the beach and look for small sponges that have been left high and dry by the tide. Take a few of them home and extract the sand from them by shaking them inside a jar or paper bag after they are dry; or by washing them in a jar of water. If you do not live within walking distance of the beach, you may be able to purchase, at paint stores, sponges that still contain some sea sand. Such sponges are sold to painters for washing woodwork and making stipple patterns, and are not as carefully cleaned as drug-store sponges.

MARVELOUS COLORS AND SHAPES

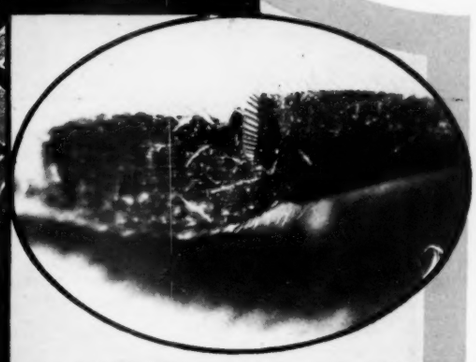


CAMERA REVEALED THIS ATTRACTIVE DESIGN

The picture above looks like embroidery but in reality it consists of a human spine seen in cross section



Left, strangely artistic forms found in beach sand. The one at far left has typical spiral of growth shape that is characteristic of many of the foraminifera



Above, photomicrograph of a honey bee's knee showing the wax pincers on one of the legs. Left, scales from the wing of an insect suggesting a pattern for wall paper or fabric

By
Morton C. W*alling*

to Design Art Patterns

After you have collected a few hundred grains of sand, arrange them on a glass slide or a watch glass, and examine them at moderate power, say thirty to fifty diameters. You will be surprised at the great variety of forms and colors you see. Little red specks that look like microscopic rubies, glittering bits that might be tiny diamonds, jet black particles—in fact, more shapes and hues than you imagined could exist in sand. Any one of these bits might serve as inspiration to an artist: but you are looking for the spiral of growth.

Here is something! Your lenses reveal a glistening white object that looks like a ball but is not exactly spherical in shape. Vary the light a little and you discover that it is a tiny shell, beautifully spiraled, and resembling the familiar snail shell or that of the chambered nautilus. You have found the magic curve. It is seen as the boundary line between the shell coils. Notice how it expands as it continues outward from the center. This expansion always is in a fixed degree, and is such that the tiny marine creature that made it could increase in size without changing its shape.

Further search will reveal other shells among the sand grains. These collectively are known as Foraminifera, and are widely distributed. They make up the chalk formations found in many parts of the world. You will discover that the shapes assumed by the foraminifer shells vary, not all of them exhibiting the curve of growth clearly.

This curve has been adopted and used widely by artists everywhere, even those of ancient times. You will find it in examples of Greek art that were completed centuries ago. It is frequently used in architecture, furniture designing, and similar fields today.

A master designer of fancy fabrics or tile floors might well have followed the plan upon which certain plant membranes are made. Soak some beans and other seeds in water over night, and then tear them apart to free the thin layers of tissue between the tough outer covering and the inside kernel. Treat small pieces of this tissue with a stain, such as methylene blue, mount them on slides, and look at them at 100 diameters. Do you know of any man-made design that is more attractive?

Another way to find the beauty in plant specimens is to cut stems, flower buds, flower parts, and leaves into thin cross sections. You can do this easily with the aid of a sharp razor and a piece of cork or cardboard as a cutting block, or you can employ a microtome if you have one. It is fascinating to treat the plant sections with various stains. Some parts take one color more readily than others so that a specimen, after being subjected to two or three stains such as methylene blue, eosin, and methyl green, presents an almost unbelievably beautiful appearance. Flower buds, because of the symmetry of their parts, produce striking patterns when sliced into thin sections. Fresh plant material is examined best in water, under a cover glass.

Another source of plant beauty is the pollen of flowers. The grains, some fairly large as microscope objects go, and others extremely tiny, are found in a wide variety of shapes. It is easy to collect pollen. Simply touch a clean slide against a flower, in such manner that the pollen comes in contact with the glass, to which some of the grains will adhere.

Of surprising delicacy and symmetry are the tongues of certain insects and other small creatures. The tongue of a cricket, for instance, looks like a design traced by a master penman. That of a snail resembles a microscopic mesh bag produced by some expert silversmith. Tongues can be secured for observation by boiling the entire animal in lye solution, which dissolves away the fleshy parts. The tongues of butterflies, bees, and the like protrude, and are observed without particular preparation. Sometimes *(Continued on page 108)*

Strange Things

Why a New Impetus Has Been

WORLD'S SMALLEST BIBLES. Collecting tiny objects is the recreation of a San Francisco man. Above are several of his Bibles, smallest ever printed, so tiny are they that a number can be held in one hand

By

Thomas M. Johnson

THERE was an early and wealthy Roman, named Petronius, who collected drinking cups. Far and near he sought them, paying generous prices for specimens to add to his collection. The gem was a beautiful crystal bowl, over which he gloated. Proudly he displayed it to his friends, even to the Emperor Nero. The tyrant's eyes glittered with desire. Next day, soldiers called upon Petronius. They handed him a flagon containing deadly poison.

"The emperor commands that you drink this," they told Petronius, "and, give us the crystal bowl to carry to him."

To refuse, meant lingering death by torture. Petronius poured the hemlock into the crystal bowl that had aroused the emperor's cupidity, and drank it. Sadly, lovingly, he gazed upon the beautiful bowl. Then suddenly, he dashed it to the floor. It shattered in a thousand twinkling fragments.

"If I cannot have my crystal bowl," cried Petronius, "no one else shall have it after I am dead, not even Nero."

Today, one reads this advertisement:

"Will exchange liquor or beer labels with other collectors. I maintain a large duplicate stock. Mail your duplicates."

A contrast between ancient and modern, yet, underneath, a similarity. Always the collector, entranced with his collection, has made sacrifices and efforts to preserve and extend it. Today there are more collectors than ever before, what with the leisure of the depression and the New Deal, and the example of Franklin D. Roosevelt. The President is said to have fifteen separate collections, among them his 25,000 stamps, and his ship models and nautical prints.

Every healthy boy's life is punctuated by collections—bird's eggs, arrowheads, marbles, stamps. Professor Edward L. Thorndike, famous Columbia University psychologist, advises the grownups to do as the boys do and find happiness and relaxation in collecting something. Not just stamps, coins, arrowheads, antiques, old prints or old china, but extraordinary things are collected, as for instance:

"Mineral collection, formed by State Geologist. Excellent museum specimens. Will trade for Jivarro Indian shrunken heads, Peruvian mummies."

"Petrified man wanted. If you have one, or can get one, write immediately."

A man in Auckland, New Zealand, collects fishes' earstones. Yes, fishes have them—all but sharks, dog-fish, and stingarees. There are six, but it takes an expert collector to find more than

CANDLES TO BURN. A few of the hundreds of candles of all kinds in this collection are shown in the photo above, along with their candlesticks

HE LIKES BANKS
Paul Scott, Glendale, Calif., has long been busy gathering toy banks of which a few are shown

DOLLS OF ALL NATIONS. Mrs. Fred Sutherland of Pasadena, Calif., is seen at right with a few of the many dolls she has secured from all parts of the world where such toys are in use

People Collect

Given to a Group of Ancient Hobbies

four. They lie hidden in the fish's brain, and through them, in a deep groove, runs the fish's acoustic nerve. The stones are of lime, formed into dainty shapes. The New Zealander displays them in a box of small compartments with the floor painted black, to bring out their delicate construction.

The Prince of Wales has unusual collections, including embroidery, knitting, and crocheting. He not only collects his specimens, but he makes many of them himself. King George has a $600,000 stamp collection. King Victor Emmanuel of Italy is one of the world's greatest collectors of coins.

A famous collector of unusual books is J. P. Morgan, who specializes in ancient tomes of ecclesiastical law and Church history. Some of them have been restored for him with gum and paper pulp by Pope Pius XI who collects early Christian documents. Another financier, Bernard Baruch, collects romantic fiction. Carl H. Pforzheimer, broker, saves Bibles, and has paid $60,000 for one.

Gene Tunney collects rare wallpaper. Aldous Huxley, English author, and Ed Wynn, American comedian, save hats of all sorts, of which Wynn has three hundred. Percy H. Johnston, banker, has a remarkable assortment of canes, including one carried by Rasputin, the Russian monk, and one of wood from Abraham Lincoln's home. Another financier, Matthew C. Brush, has 1,500 elephants—miniature, of course, and of all materials from ivory or jade to wood or rubber. Theodore N. Vail, late telephone magnate, collected old Japanese sword guards and was an active member of an elite organization of collectors that included prominent industrialists and financiers.

AGENTS OF DEATH Pasadena's probation officer, Earl Smith, has a passion for cartridges and he now has over 2,000 of them of different sizes and shapes

TIN SOLDIERS ON PARADE Walter Lockwood, London, England, is commander of the largest tin-soldier army in the world. After thirty-five years of effort his home is filled to overflowing with the small tin toys

One of the most extensive collectors today is Henry Ford. He is said to have spent $15,000,000 to stock his museum at Dearborn, Mich., with countless collections of Americana, just "common things" that, a while back, formed part of everyday life in this country.

Another great collector is W. Parker Lyon, Pasadena, Calif., expressman and former Mayor of Fresno, now sixty-eight. For sixty years he has been collecting, starting at eight with stamps, and four years ago he built on his estate, Sunridge, a separate museum, partly of buildings that are themselves relics, moved from General Fremont's home in Bear Valley, northern California. The museum keeps alive the glad, bad days of the Wild West and the Gold Rush, that thrill every boy and man. The gems of the collections are stage coaches of pioneer days, bullet-riddled and arrow-scarred. There are prairie schooners, a fire engine of 1858, and one entire blockhouse, with barred windows.

There is a stump from a cottonwood tree on which fifty-six horse thieves were hanged. There is a complete mining town saloon, with a bullet-marked bar of Gold Rush days, a roulette wheel and a faro layout, and many old barroom paintings. There are spinning wheels, pioneer women's clothes, and revolvers used by notorious killers, Indian scalping knives and other weapons. Lyon's specialty is "franks," the homemade stamped envelopes used by the private companies that delivered mail to the early settlers. For a single envelope he has paid $500 and he has 400 albums that he values at $100,000. His whole collection is worth several times that, and draws visitors from all over the world. *(Continued on page 114)*

HE HAS PLENTY OF TIME. W. C. Fuller, Seattle, Wash., gets a lot of fun out of collecting clocks. He has them of all styles and dates and is still constantly looking for others

In this steel ball, which is thirty feet in diameter, the sea's floor, half a mile below the surface, will be explored and studied through glass ports

STEEL GLOBE FOR DEEP SEA EXPLORERS

A HUGE steel ball, capable of withstanding the tremendous pressure encountered half a mile below the ocean's surface, has been constructed in France for a projected exploration of the sea floor. The design was made by Georges Claude, noted French scientist, who will conduct the explorations. The sphere is thirty feet in diameter and will be equipped with transparent ports for visual observation. Hose lines will supply air.

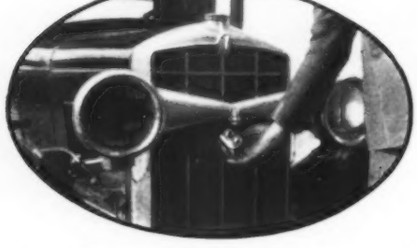
AIR BLAST SHOOTS HOT RIVETS TO STEEL MEN

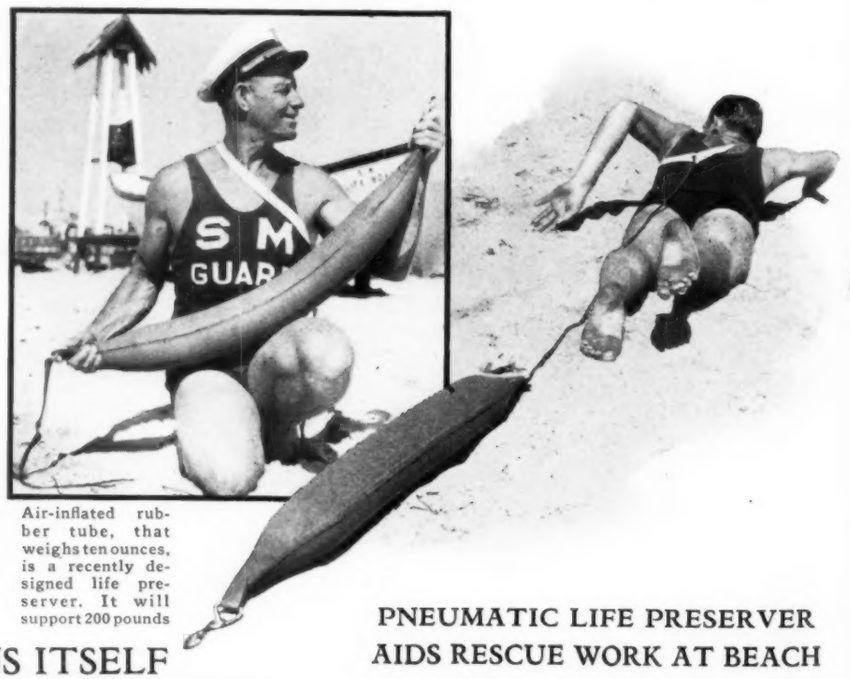
THE spectacular but dangerous practice of tossing white hot rivets through the air from forge to riveter has been supplanted on the Golden Gate Bridge, now under construction at San Francisco, Calif., by a pneumatic tube rivet-passing system. The hot rivet is merely dropped into the tube and shot to its destination by a blast of compressed air. As a further safety measure, all workers on the bridge wear steel helmets to protect them from accidentally dropped tools.

Through these tubes, hot rivets are shot to workmen on the Golden Gate Bridge by means of blasts

MIRRORS ON CAR THROW LIGHT TO HEAD LAMPS

BY THE use of reflecting mirrors, a Michigan inventor has devised a set of headlights to overcome the menace of one-eyed cars. Behind each headlight is a hollow cone. These cones are joined at the center line of the radiator where two headlight bulbs are inserted. The cones act as reflectors and the reflected light is bent through the headlight lenses by mirrors. Should one of the bulbs burn out, the remaining one, the inventor asserts, would supply light to each headlight.

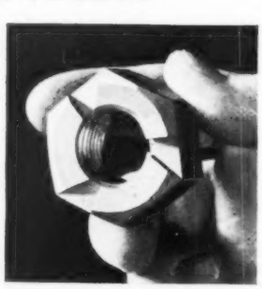




Air-inflated rubber tube, that weighs ten ounces, is a recently designed life preserver. It will support 200 pounds

MACHINE NUT CLEANS ITSELF

A MACHINE nut that cleans itself has been devised by a Spelter, W. Va., inventor. Three grooves on its face, shown in the photograph at right, remove grease and grit from its path when it is unscrewed, preventing foreign matter from working into the threads and damaging them. According to the inventor, the self-cleaning nuts have proven satisfactory at points in a factory where the old method of removing a nut was to cut it off with an acetylene torch.



PNEUMATIC LIFE PRESERVER AIDS RESCUE WORK AT BEACH

REMARKABLY light and bouyant is the rescue device that has replaced the more cumbersome life preservers once used by southern California beach guards. The new life raft is a tube of thick rubber, long enough to be wrapped about a drowning person's body. It weighs only ten ounces when fully inflated but will keep a 200-pound man afloat. A swimming life guard can tow as many as four of the tubes and by snapping a spring-locked hook at one end of the tube into a ring at the other end they can easily be fastened about the bodies of the persons to be rescued. The guards, keeping clear of the struggling victims, can bring them to shore.

The Man with the Net

ONE OF THE FIRST *musical instruments in the world was a lion's tooth. In Central Europe, archaeologists have found a pipe fashioned from such a tooth 30,000 years old.*

AN ENGLISHWOMAN *has put 1,000,000 stars in their exact places on a map of the sky.*

EXAMINATION *of more than 3,200,000 motor vehicles last year showed three out of four had defects which made them dangerous on the highways.*

CRICKETS *are used as watch dogs in Japan. Kept in cages, they stop chirping if a stranger enters during the night. The sudden silence wakes the master.*

SIX THOUSAND *dollars is the highest price ever paid for a butterfly. That was the cost of an expedition from England to Central Africa to get the first female of the species Drurya Antimachus.*

A CLAM *that weighs twice as much as a man grows in the South Seas.*

THE ONLY *book in the world that contains no printer's mistakes is said to be the Modern Oxford Bible.*

STILL AND MOVIE *caricatures are produced by a new auxiliary lens invented in England. It gives distorted images of faces and figures.*

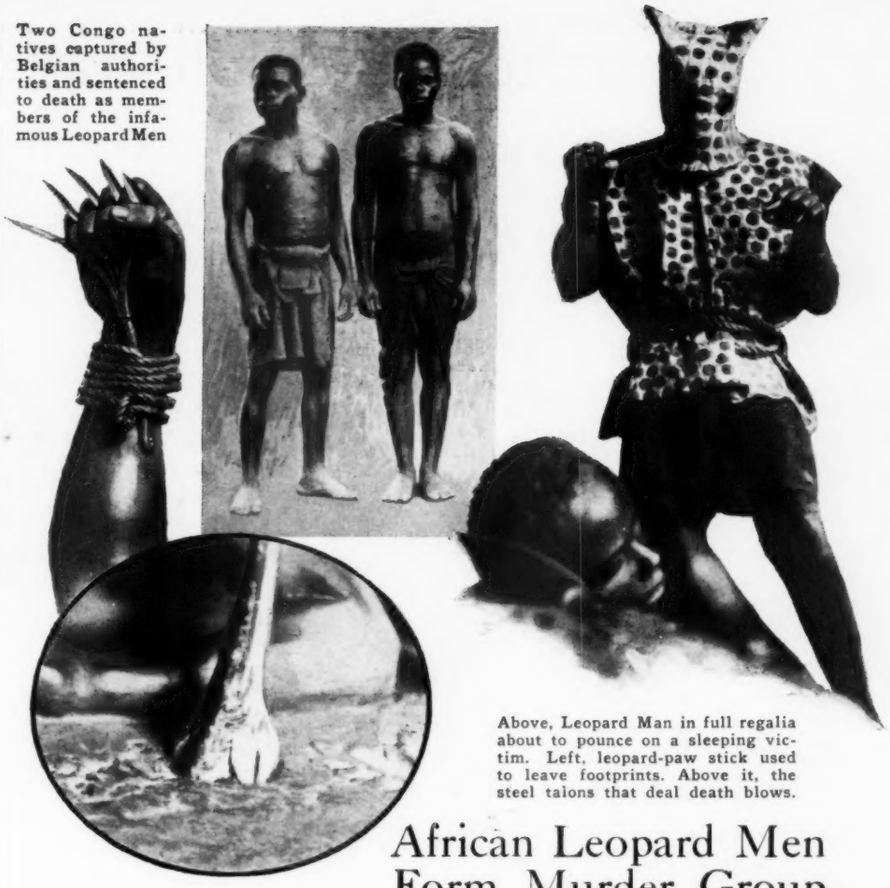
A RABBIT *can stand more morphine than a man can.*

IF ALL *the offspring of a single oyster lived until it had great-great-grandchildren, their shells would make a pile eight times the size of the earth.*

A SHELL *so powerful it will travel nine miles after piercing steel armor as thick as itself, has been produced in England.*

THE FEMALE *falcon is bigger, stronger, and can kill larger prey than the male.*

Two Congo natives captured by Belgian authorities and sentenced to death as members of the infamous Leopard Men



Above, Leopard Man in full regalia about to pounce on a sleeping victim. Left, leopard-paw stick used to leave footprints. Above it, the steel talons that deal death blows.

African Leopard Men Form Murder Group

THROUGH the capture of a number of its leaders, government authorities are reported to have confirmed officially the existence of a ferocious tribe or cult known as "Leopard Men" in the Belgian Congo of Africa. Fiendishly picturesque as any cannibals or head-hunters, according to fantastic tales that have reached the ears of explorers in the past, these savages arm themselves with metal talons like leopards' claws in order to seize and rend their victims. Such fragments of native lore are now supported by evidence developed before a tribunal at Wamba, which convicted and condemned to death eight captives, supposed to be "Leopard Men," for murders committed in a raid on a native village.

From these various sources it is now possible to piece together a fairly connected version of the activities of this mysterious clan. It appears to be no roving band of jungle dwellers, but a well-organized cult of fanatics drawn from the ranks of a tribe known as the Aniotos. Native blacks of the villages, particularly those who show friendliness to the whites, are reputed to be the favorite prey of the Leopard Men. To carry out his vengeance, the Leopard Man dons a cloak and headdress fashioned from tree bark and mottled in the pattern of a leopard's pelt. Talons of forged iron, terminating in razor-sharp blades, are next bound to the wearer's wrists, and he grasps these so the points project between his fingers. A short staff, its tip carved in the shape of a leopard's paw, completes the assassin's equipment.

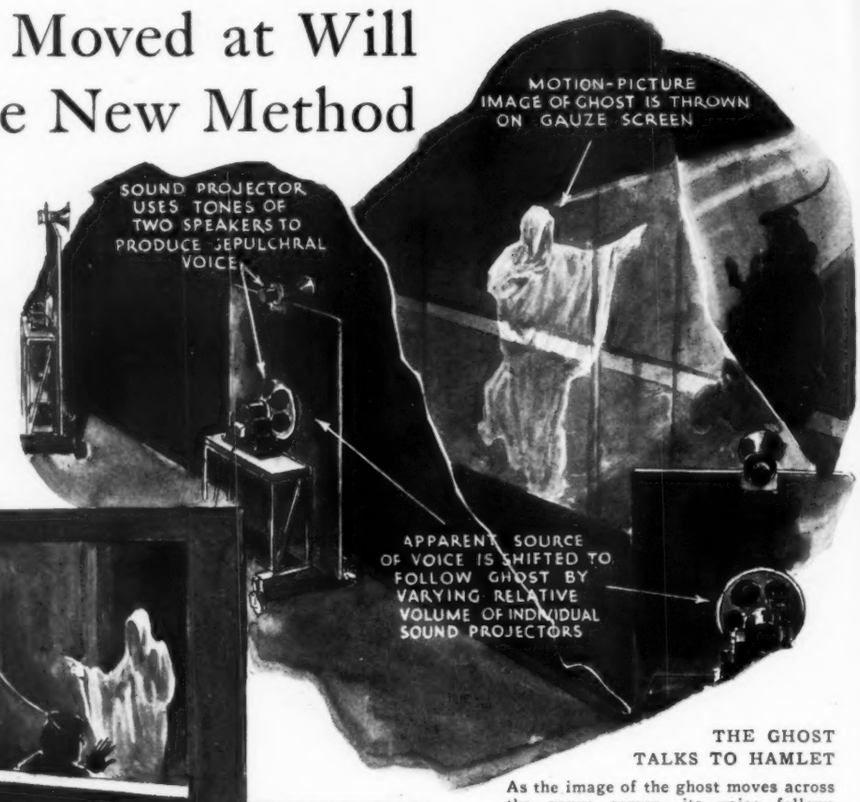
Thus accoutered, the Leopard Man steals at night into the hut of a sleeping native. A quick slash of the talons severs the victim's throat. The murderer then completes his mimicry of a wild beast by marking the body with the imprints of his talons, and leaving a trail of footprints with his leopard's-paw stick. Aroused by the murders, the Belgian government has started a campaign against the killers.

SCREW DRIVER CARRIED IN ONE END OF PENCIL

CONCEALED under the removable cap of a new pencil is a small but practical screw driver. The blade is firmly attached to the pencil barrel, which is of a hard composition and is strong enough to form a dependable handle. The cap over the screw driver is easily removed by twisting slightly. By this unusual combination a necessary tool can be carried conveniently in the vest pocket so it is constantly at hand for instant use.

Stage Sounds Moved at Will by Remarkable New Method

ADAPTING advanced scientific methods of controlling sound to theater use, Prof. Harold Burris-Meyer, of Stevens Institute, Hoboken, N. J., recently demonstrated dramatic effects never before attainable. Upon the stage of the institute theater, a translucent phantom representing the Ghost in "Hamlet" was given a voice that followed it wherever it moved. Actually, this was the voice of a man speaking into a microphone offstage. His tones were first artificially altered to give a sepulchral sound, and then reproduced as explained in the accompanying sketch and diagram, which show how the apparent source of sound was shifted. Pantomime dancers seldom have breath for vocal efforts, so Prof. Burris-Meyer supplies them with made-to-order voices by a similar method. Speech and music that seem to come from any point within the length and breadth of the theater, as well as mysterious sounds having no identifiable source, are produced at will by carefully worked-out combinations of from five to eleven loudspeakers of diverse types. Through a bit of electrical magic, an audience can hear actors conversing in normal tones above loud music. Their voices, picked up by microphones on the stage, are applied electrically to damp out, or suppress, interfering portions of music transmitted at full volume from an orchestra playing in a nearby laboratory. During a performance, a sound technician, with script and stage directions before him, cuts speakers and microphones in or out as required, and handles the maze of jacks, cables, and dials that control the complex equipment. His control room also contains auxiliary apparatus, such as a phonograph pick-up, a vacuum-tube oscillator providing an eerie wah-wah tone for special effects, and a loudspeaker enabling the operator to listen in on the entire performance. New thrills for theater audiences, through application of the new sound technique are foreseen by Prof. Burris-Meyer.


MOTION-PICTURE IMAGE OF GHOST IS THROWN ON GAUZE SCREEN
SOUND PROJECTOR USES TONES OF TWO SPEAKERS TO PRODUCE SEPULCHRAL VOICE
APPARENT SOURCE OF VOICE IS SHIFTED TO FOLLOW GHOST BY VARYING RELATIVE VOLUME OF INDIVIDUAL SOUND PROJECTORS

THE GHOST TALKS TO HAMLET

As the image of the ghost moves across the gauze screen, its voice follows it and always seems to issue from the exact spot where the figure is standing

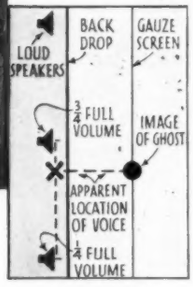
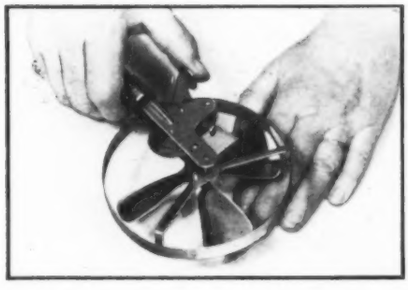


Diagram shows how weird effects are produced on stage by loudspeakers



HAND-DRIVEN FAN DRIES FINGER NAIL POLISH

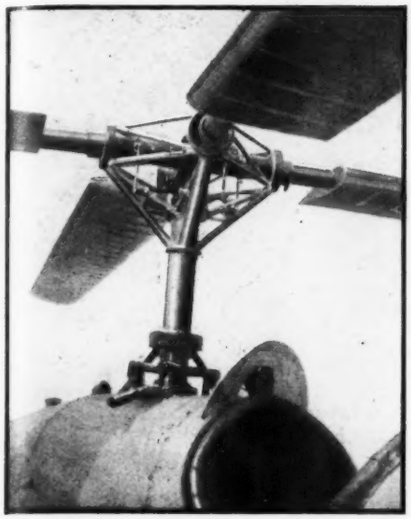
POLISH applied to finger nails can be dried quickly with the aid of a new hand-operated fan. Held as shown above, the fan is actuated by pressing a short lever with the thumb. A ratchet turns the fan blades at surprising speed, directing a stream of air upon the nails which quickly dries them.

ROBOT MARKS TIME AS STUDENTS DRILL

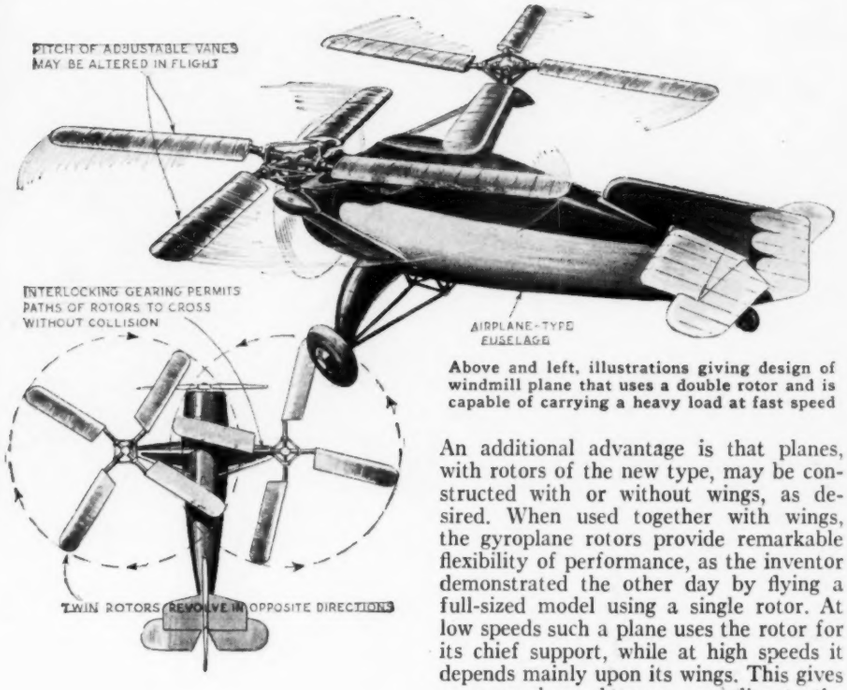
A MECHANICAL assistant devised by the drillmaster of the student corps at the University of Kentucky is being used to mark time for his prize-winning unit. The robot speaks through an automobile horn and its voice, honking at measured intervals, can be heard all over the parade ground. An electrically driven phonograph turntable making two contacts at each revolution furnishes the impulses to operate the horn. The rotation of the turntable can be regulated to any speed.

Auto horn, timed by phonograph turntable, keeps marchers in step

Double Gyroplane Has Speed and Power



This close-up of gyroplane using one rotor, shows how rotor, with adjustable vanes, is mounted


PITCH OF ADJUSTABLE VANES MAY BE ALTERED IN FLIGHT
INTERLOCKING GEARING PERMITS PATHS OF ROTORS TO CROSS WITHOUT COLLISION
AIRPLANE-TYPE FUSELAGE
TWIN ROTORS REVOLVE IN OPPOSITE DIRECTIONS

Above and left, illustrations giving design of windmill plane that uses a double rotor and is capable of carrying a heavy load at fast speed

BY ADAPTING the principle of the windmill plane to transport machines capable of carrying large loads of passengers and freight, E. B. Wilford, Philadelphia, Pa., inventor, plans to extend the usefulness of this type of craft. For this purpose more than one rotor would be employed. Our artist shows the design of a twin-rotor plane for which Wilford has just received a patent. Outwardly the windmill vanes of the gyroplane, as Wilford has named his machine, resemble those of conventional aircraft of this type. Close inspection shows an important difference, however. The vanes of the gyroplane, unlike those of other craft of similar appearance, are adjustable in flight, adapting it to economical operation under widely varying conditions of load, speed, and elevation.

An additional advantage is that planes, with rotors of the new type, may be constructed with or without wings, as desired. When used together with wings, the gyroplane rotors provide remarkable flexibility of performance, as the inventor demonstrated the other day by flying a full-sized model using a single rotor. At low speeds such a plane uses the rotor for its chief support, while at high speeds it depends mainly upon its wings. This gives an unusual speed range, according to the inventor, permitting the craft to speed as fast as 180 miles an hour or to land in a restricted space at only thirty miles an hour. The adjustable vanes may be feathered at any time during flight to offer a minimum of resistance, and may be held stationary by a brake until there is enough wind to turn them.

SHAKER TESTS CAR'S RADIO

A NEW laboratory proving ground for automobile radio sets punishes a set as much in five hours as would be done ordinarily in three years of hard driving. Clamped to a hinged platform, the set is bounced up and down by an electric motor. The blows are repeated at the rate of 3,425 a minute and each is equivalent to driving a car over an eight-inch rut at forty miles an hour.

Clamped to this hinged platform, a car's radio set is bounced up and down by an electric motor to test its endurance

NO GEARS IN SILENT LAWN MOWER

WHIR and clatter are eliminated from the lawn mower in a new noiseless machine. This mower employs no gears, V-belts being used to rotate the cutter blades. The belts pass through grooves in the wheels and thence over the cutter-shaft pinions. Rubber tires on the wheels further reduce noise. Since no friction bearings are used in the mower, its use is said to require surprisingly little effort on the part of the operator.

Beating Paddles Propel New Boat

FLAIL-LIKE paddles, designed to beat the water instead of pushing through it, are used to propel a new German boat. First one and then the other paddle is raised from the water by means of hand levers and then lowered. Paddles are so curved that their descent into the water imparts motion to the boat. Good speed is said to be possible, in the direction faced by the boat's occupant, and at the expenditure of considerably less effort than is necessary in the ordinary type of rowing with oars.

Above, boat with flail-like paddles is seen out of water. At right, the boat in water and paddles worked by hand levers

FLOWERS HARVESTED LIKE WHEAT

INSTEAD of being picked tediously by hand, flowers are harvested like grain in a new method worked out by agricultural experimenters in Missouri. The flowers are those of pyrethrum, a species used for many years in the manufacture of a powdered insecticide. When fully developed, the blossoms are cut by an ordinary reaper and binder. The bound sheaves are stacked like wheat and allowed to dry. Dried blossoms are then separated from the stems by a conventional threshing machine.

Flowers, from which a powdered insecticide is made, are now harvested with a reaper and binder exactly as wheat is harvested. The sheaves are stacked like grain and allowed to dry thoroughly

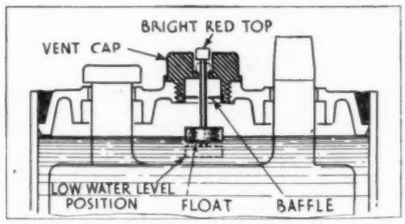
MACHINE HELPS SICK PERSONS BREATHE

ARTIFICIAL respiration is applied to a patient automatically for days or weeks at a time by a new portable respirator of British invention. Contrasting with the large, tanklike devices introduced not long ago in this country, the latest device is compact and inexpensive, and permits the patient to move about freely in bed. It consists of a rubber bag securely wrapped around the patient's chest and intermittently inflated with air, the gentle periodic pressure aiding the patient to breathe normally. The apparatus was devised by Sir William Bragg, eminent British scientist.

Model of the electrically operated machine that applies artificial respiration to those unable to breathe

CAR GAGE WARNS WHEN BATTERY NEEDS WATER

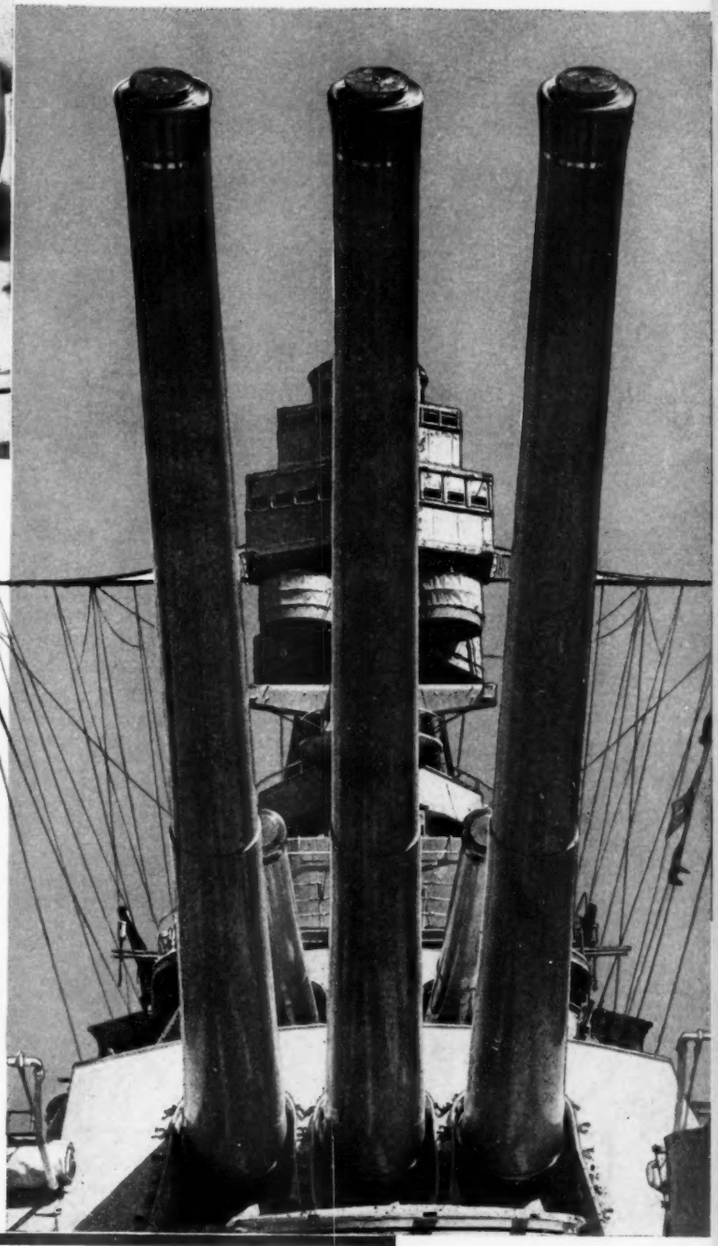
WHEN a car's battery needs water, a new float-operated indicator calls visual attention to the fact. The device, built into a vent cap, consists of a short plunger with a bright red top and a float attached to the lower end. When water in the battery is at the proper level the red top is level with the vent cap and is readily seen. When the red top drops out of sight it indicates that water is needed.



At top, close-up of car gage that indicates the state of water in battery. Above diagram of gage

YOU CAN STILL SEE OUR MECHANICAL WONDERLAND

YOU still have time to visit POPULAR SCIENCE MONTHLY'S Mechanical Wonderland at the Chicago World's Fair. Thousands of enthusiastic visitors, both young and old, enjoyed the remarkable working models last year and as a result it is again on exhibition. It is on the second floor of General Exhibits Building One, adjoining the Hall of Science.



Invisible Targets

IN SEA OR SKY HIT BY Navy's Miracle Guns

SEVEN thousand yards farther than spotters in the tops can see, higher into the skies than airplanes are visible from earth, Uncle Sam's big naval guns can spread destruction with an accuracy impossible only a few years ago.

All the forces of military and naval science are centered in these powerful weapons. Guided by aerial eyes and mechanical brains, the fourteen battleships can shoot beyond the horizon, dropping on their objectives 240 tons of high-explosive, armor-piercing shells weighing 1,400 pounds each, every minute.

Big gun firing on the high seas offers a complexity unknown during the World War, yet trained officers and men fire these huge weapons with rapidity, ease, and accuracy at targets far beyond their vision.

Pointers and trainers who may not know at what they are shooting, sit beneath the long steel guns, protected by heavy armor plate,

Above, three fourteen-inch guns on the Pennsylvania set at an angle of thirty degrees. They can hurl their 1,400-pound projectiles two miles into the air and hit a target nineteen miles away. At left, sight setter adjusting range and deflection in accordance with orders received by phone

By

ANDREW R. BOONE

•

This remarkable view of the *Texas* and *New York*, firing off the southern California coast, was taken during recent gunnery practice. Ten fourteen-inch guns, in five turrets, are being fired simultaneously. Note flash in the foreground caught by camera after the gases left the gun

and match two pointers with others set electrically by a mechanical-electrical-manual range keeper, while others in the close quarters of the turrets correct the guns' elevation and direction to allow for the projectiles' time of flight toward the target.

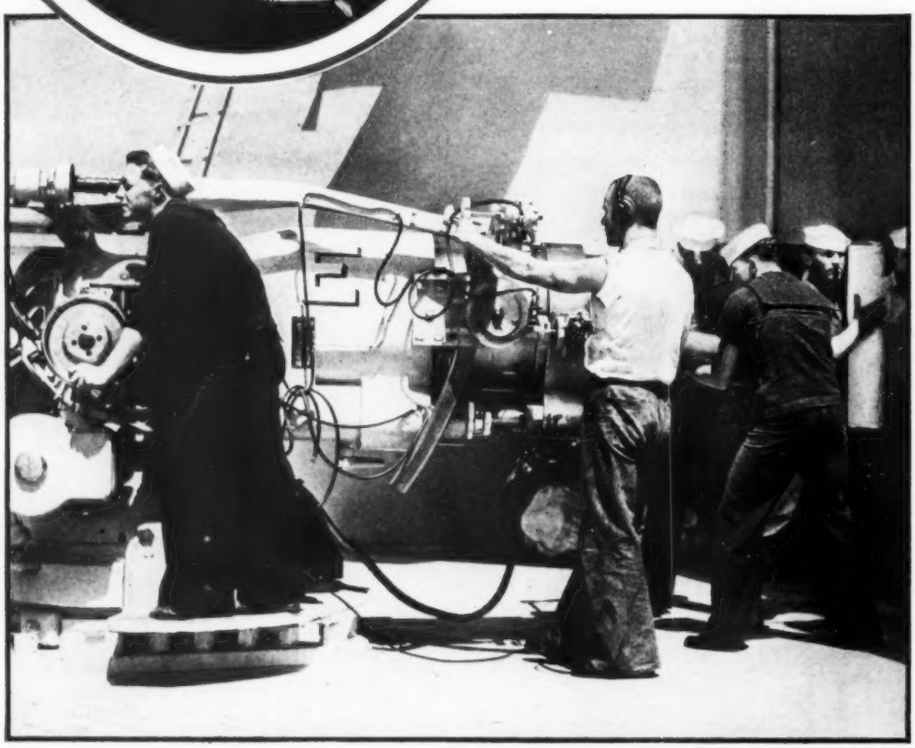
How are the continually changing direction, distance, and speed of the target made known to the gun crews? How are the big guns supplied with ammunition and fired? How do the anti-aircraft weapons, marvels of precision, lay withering barrages higher in the heavens than naval planes can fly? How are the shorter-range broadside batteries able to pour a devastating fire—fifteen shells a minute from each gun—onto targets their crews cannot see?

When the battle force sights an enemy, represented during practice maneuvers by rafts towed behind powerful tugs, skilled observers in the tops start the range finders. High above the water line, they can see beyond the horizon the tops of the targets, though they are not yet within firing range.

The battleships send their observation planes into the air. From each ship three planes are exploded into the wind from catapults actuated by charges of powder. As the pilots fly over the enemy they note his course, speed, and composition. In code, this information flashes back to the battleships.

As soon as the range finders indicate the target has come within reach of the big guns, the first salvo is fired. Aviators send back the spot, that is report how the big shells have fallen with reference to the targets they aimed to hit.

Once the initial range is determined, all available data are assembled and poured into a mechanical brain. From this time on, the robot range keeper directs the guns. It is a giant computer, operated electrically, mechanically, and by hand. The information it sends the guns is more nearly accurate



In oval, five-inch anti-aircraft guns that fire higher than the gunners can see. Their projectiles burst several miles above the ocean and endanger planes within 400 feet in every direction. Each gun can fire fifteen shells a minute. At left, crew at a broadside gun preparing to fire on a target at short range during gun practice

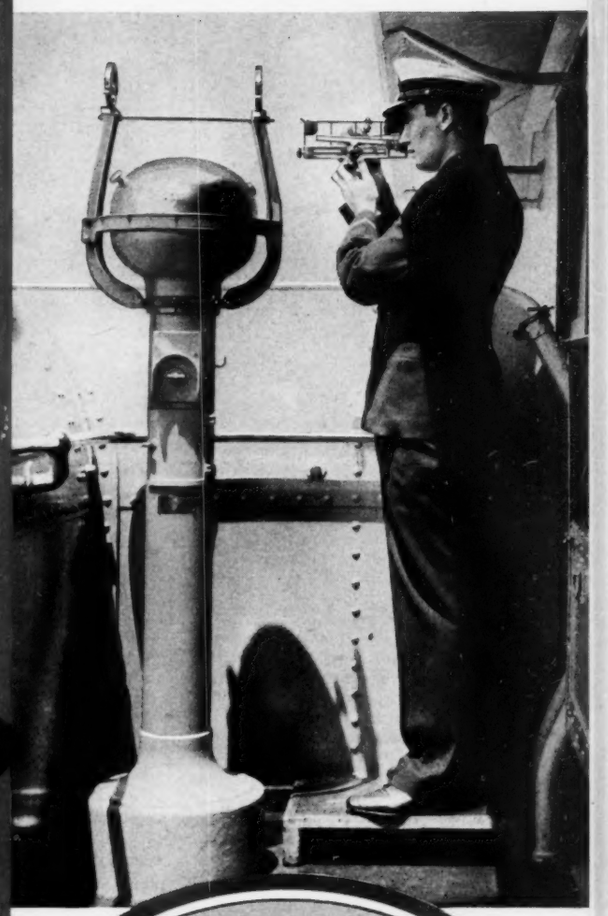
Giant Projectiles Hurled Beyond the Horizon by America's Fleet in Remarkable Demonstration at Sea

than that which goes into it. Into the computer are fed the estimated direction and speed of the enemy, the course and speed of its own ship, the range to the target and the direction and velocity of winds aloft. As firing progresses, corrections radioed back by the spotting plane are applied and the whirring brain transforms these data into elevation and direction for the big guns.

If the aviator spotting the falls of the projectiles observes them correctly, the guns should stay on the target.

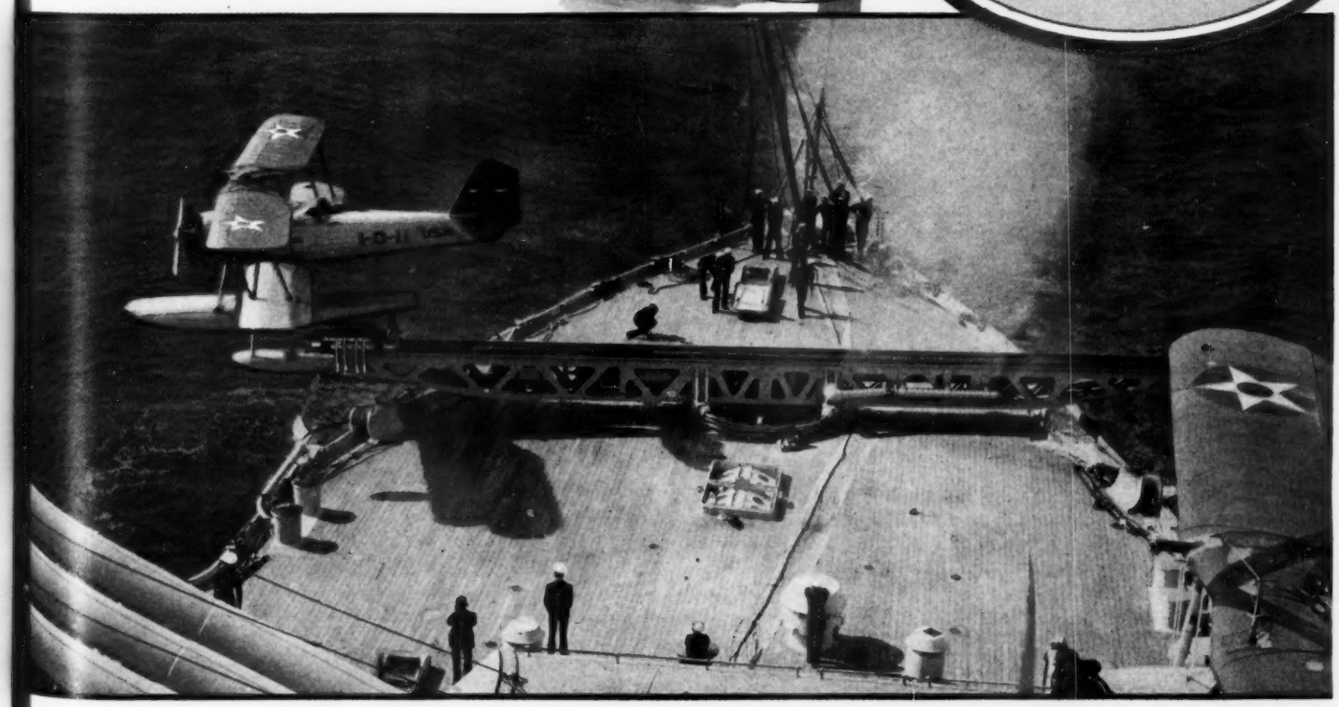
Unlike ordinary rifle fire, the factor of wind drift must be considered if accuracy is to be achieved with the big guns. The shells bore their way upward through the air as high as two miles at high-angle, long-range fire. At those high altitudes, they frequently scream through winds blowing in the opposite direction from those along the surface. For this reason a weather officer sends up a small balloon a short time before the ships fire and reports on the winds to all ships. A thirty-mile wind at that altitude would blow a sixteen-inch shell as far as 1,500 feet off its course before it descended.

The ultimate secret of excellent gunnery lies, of course, in hitting the target. To achieve this, the Navy makes use of two systems of fire. In one the guns are kept continually elevated and on the target, being fired as the ship reaches the top or bottom of the roll. In the other, the guns remain at a fixed elevation and fire at the precise instant the individual ship swings across that line as she rolls. They may be fired from any of six stations scattered through the giant ships. Of these the plotting room is best protected, by



While the ships fire, a bearing is taken on the target with the pelorus, shown at left above. From these data the range is determined. The officer is using a stadimeter to check the distance between his ship and the one ahead. At left, a fourteen-inch shell weighing 1,400 pounds

Below, an observation plane takes to the air. Hurled by the seventy-two foot catapult, it attains a speed of sixty miles an hour as it is released. Note smoke in the air over the rear of catapult, proving plane is really shot aloft



This sub-caliber gun, resting in the shadow of its big brothers, on the *West Virginia*, is used in practice firing at distant targets which saves wear and tear on the big fellows. Even during recent maneuvers these guns were in use

all the side armor, against hostile gunfire.

Though the heavy pieces are easily controlled, they must be assured a constant supply of ammunition to be effective.

Hydraulic rams shove the heavy projectiles up through metal tubes from the shell deck, twenty-five feet below. As each reaches the turret in its balancing tray, it is laid down by hand on the loading tray and rammed mechanically into the open breech of the gun.

Through a series of fire-proof doors, the silken bags of powder move from the magazines to handling rooms where conveyors pick them up and lift them swiftly up forty feet to the small rooms just outside the turrets proper. They pass through interlocking doors, which cannot open at the same time; this to prevent fire from spreading into the magazines should disaster befall the turret crew.

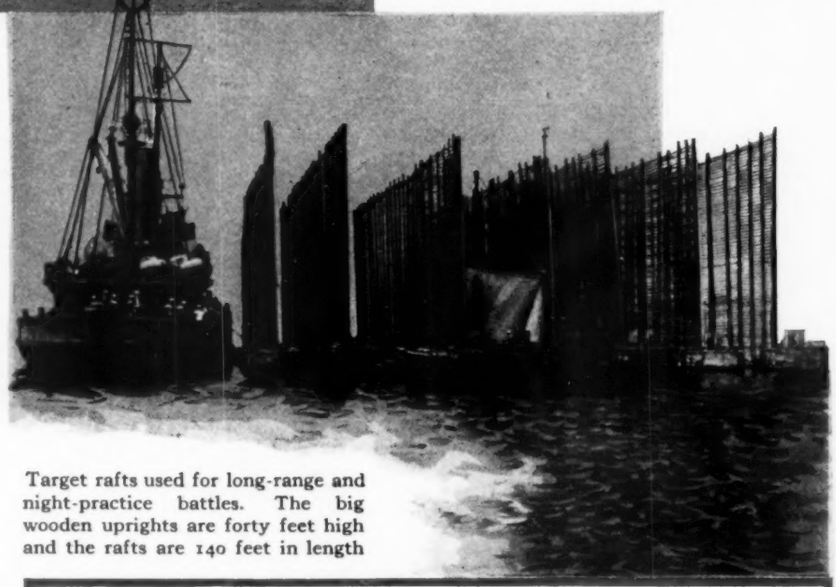
At last, the powder bags roll out through a flap door, hinged on top, onto the open spanning trays, which are shallow, brass receivers set flush with the breech of the guns. In a split-second, rammers shove the bags home, breech plugs are closed, and spanning trays are pulled up clear to permit the guns to recoil without wrecking the auxiliary apparatus by this violent movement.

Although actually the guns are fired from far-distant stations, no chances are taken. As each piece is ready, the gun captain closes a switch flashing on a signal light, notifying the turret officer the piece may now be fired. When he sees all lights burning, the turret officer in turn signals the gunnery officer that the turret is ready to fire. A few seconds later the guns jump backward on their tracks as the terrific explosion rocks the ship, quickly slide forward into position, and are ready for the process to be repeated.

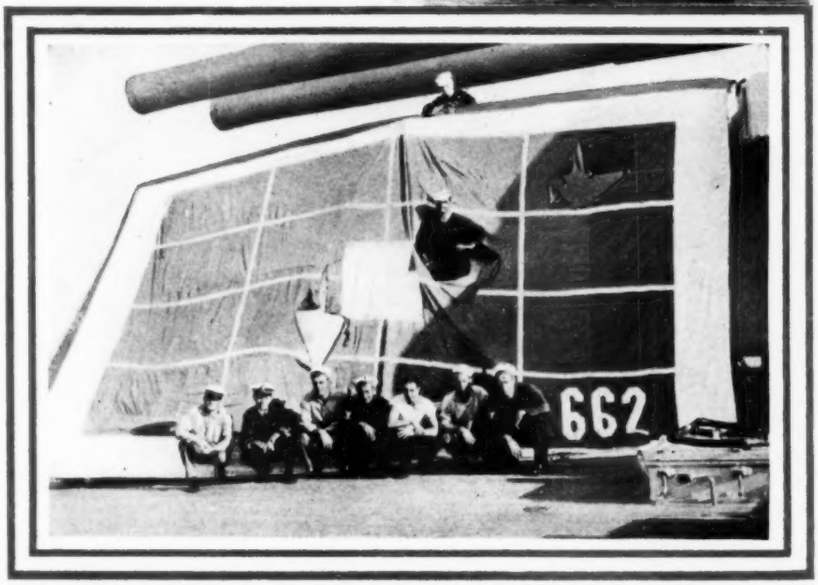
Meantime, if at short range, the broadside guns are delivering a withering fire of fifteen projectiles a minute for each of these eight weapons. Their operation seems simplicity itself. They are helpless against battleships standing off eighteen miles and blasting away, but when cruisers, submarines or destroyers venture within closer range, they take up the battle much after the manner of their bigger brothers within the turrets.

Three men, ear phones clamped tightly to their heads, run the mechanism of these weapons. As corrections are made in distant control stations, the gun layer matches pointers to elevate his piece properly, a sight setter sets the sights at the required range and deflection, the trainer matches pointers to secure proper deflection. Others of the crew shove the fifty-two-pound projectiles and long powder bags into the breach, and step back to await the firing.

The anti-aircraft batteries of five-inch guns are semi-automatic. Almost as fast as men can bring up ammunition, their shells scream into the heavens, laying a terrific barrage around any airplane that may be over- *(Continued on page 104)*



Target rafts used for long-range and night-practice battles. The big wooden uprights are forty feet high and the rafts are 140 feet in length



After short-range practice, this target was riddled with shells as is evident in the picture. The sailors who fired the guns in the sham attack are posed with the target. Note, at top of the photo, the protruding muzzles of two of the mighty guns

Any One CAN LEARN TO BE A Ventriloquist

A modern ventriloquist and his dummy. The puppet has a wide range of movements and almost human facialexpression

Head of a simple dummy of a type popular several decades ago. It could only move its lips and turn its head to the side

Constant practice before a mirror teaches the ventriloquist to talk without moving his lips or facial muscles

CUNNINGLY contrived puppets help the modern ventriloquist to produce the weird effects that fascinate theater audiences and private gatherings. Far more realistic than the "assistants" of his predecessors, these dummies now smile, weep, and wink at his will, to heighten the illusion of their borrowed power of speech. Thus clever stagecraft has brought up to date the ancient art of ventriloquism—an art as mystifying to laymen today as of old. In reality, there is nothing mysterious about ventriloquism, however. It may be mastered by anyone with sufficient patience to follow a few rules. Contrary to popular belief, a ventriloquist does not actually "throw" his voice. Every sound that he creates comes directly from his own vocal cords. His success in convincing his audience that it comes from somewhere else depends on his skill in concealing lip movements and in producing false voices. A tremendous aid to this illusion is the fact that human ears judge imperfectly the direction of a remote source of sound, as anyone may observe at a sound movie. Here voices that seem to come from the lips of actors moving about the screen actually issue from fixed loudspeakers concealed behind it. Even more faulty is the ear's ability to judge the distance of a source of a sound.

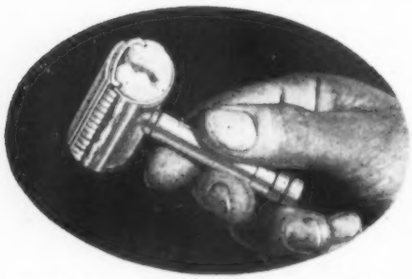
The skilled ventriloquist takes full advantage of these weaknesses, and loses no opportunity to add to the illusion by the power of suggestion. In the "near" technique that he adopts when working with a dummy close at hand, he disguises his voice by speaking in falsetto. Those in the audience, seeing only the puppet's lips move, assume that the voice is its own. To escape making telltale lip movements, a ventriloquist avoids certain dangerous words such as those containing "p" and "b" sounds. Try it before a mirror, and you will see why a ventriloquist's dummy asks for a quart of ale and not a pint of beer. Where such sounds must be used, they are slurred over. More difficult is the "distant" technique by which the performer seems to make a voice come from a remote spot, as in a conversation with an imaginary person behind the scenes. Here the ventriloquist uses strained or muffled tones suggestive of distance. These sounds are produced deep in the throat, and have no resemblance to normal speech. To practice them, try taking a deep breath, hold it, and attempting to make a sound in the throat. A gurgle will result. Now if you exhale slowly while saying "ah," a buzzing or droning sound is produced. This "drone," as it is known to ventriloquists, is the basis of all "distant" sounds, and an experienced performer acquires sufficient control of the throat muscles to make it startlingly effective. The farther back in the throat it is produced, the more remote its apparent source seems. Gestures, glances, or head movements replace the dummy of the "near" technique in suggesting the exact spot from which the sound is supposed to come. This trick is responsible for the popular impression that the ventriloquist can "throw" his voice, or make it issue from a place at some distance from the speaker.

Modern dummy that can even drink and smoke. Battery lights nose and bulb furnishes smoke

ELEVATOR LIFTS CARS IN NEW DOUBLE-DECK AUTO CARRIER

A BUILT-IN elevator enables a new streamline semi-trailer to carry three medium-sized automobiles at once. The first car loaded is run up an inclined track heading into the overhanging nose of the trailer. By means of cables, the rear end of the track is raised and another car is run under it. The third car occupies the rear. The trailer is built of lightweight magnesium alloy metal and is only forty feet long including the tractor. It is used to deliver automobiles from the factory to local distributors.

Above, trailer with rear door open, showing inclined track that raises a car. At left, side view of novel vehicle



RAZOR CATCHES LATHER

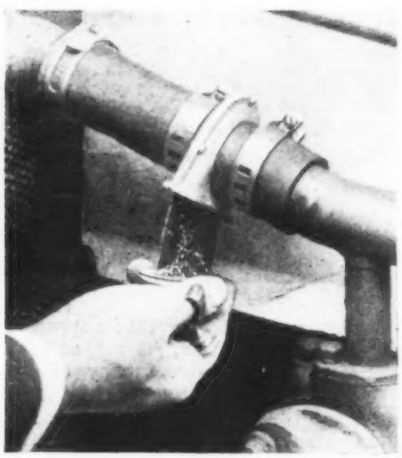
A NEW drip-proof safety razor just placed on the market in Germany makes it possible to wear a shirt while shaving without staining it with flecks of lather. A half cylinder fitted beneath the guard of the razor, as shown above, forms a cup to catch the lather as it is scraped from the face by the razor.

MIDGET MOTOR DRIVES POCKET FAN

A VEST-POCKET electric fan, recently developed, promises hot-weather relief for people in public places. It is powered with a midget motor just a little more than four fifths of an inch long, or about the size of a spool of thread, operating on current from an ordinary flash-light battery. The blades of the miniature fan are folded down alongside the case when it is carried in the pocket. The diminutive size of the motor is seen by contrast with the man's hand in the photograph.

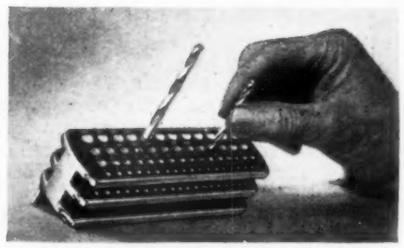
Right, pocket-sized electric fan and midget motor that drives it. Power is supplied by a flash-light battery. The blades fold up for carrying in pocket

SCREEN KEEPS RUST OUT OF RADIATOR



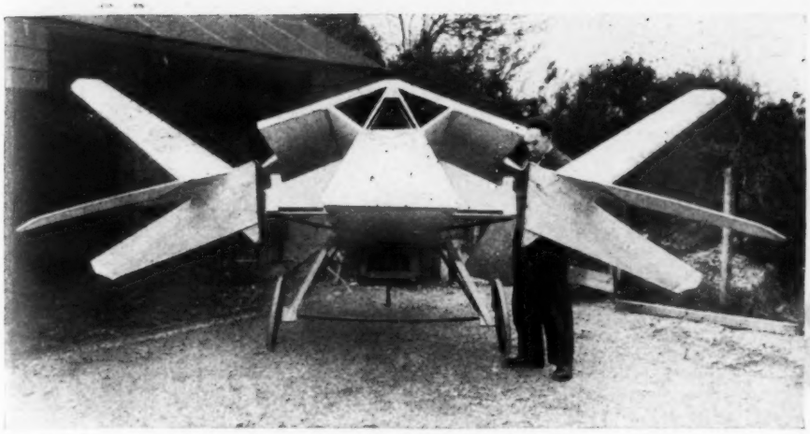
Above, device that takes rust out of automobile cooling systems. Close-up at right shows how screen is removed

AUTOMOBILE cooling systems are kept free from accumulations of rust by means of a new device designed to screen out the rust particles. It consists of a screen which is inserted in the hose leading from the radiator to the water jacket of the engine. Having a surface three times as large as the hose section, the screen permits a free flow of water. No rust can adhere to the screen, as the vibration of the engine shakes it loose. The rust particles drop to the bottom of the device, which can be easily cleaned by removing the screen. A thumbscrew makes the removal of the screen an easy matter. Installation of the device is simple, being effected by cutting a gap in the hose connection for it.



DRILL STAND IS TILTED

A DRILL of any size desired can be selected instantly from a tilted drill stand of new design. In the ordinary holder, the rows of drills obscure the numbers indicating the sizes. The new holder has a folding leaf attached to the rear edge of the base. When this leaf is extended, the holder is tilted at an angle that keeps the size numbers directly in the line of the user's vision allowing a choice of any drill to be made easily.



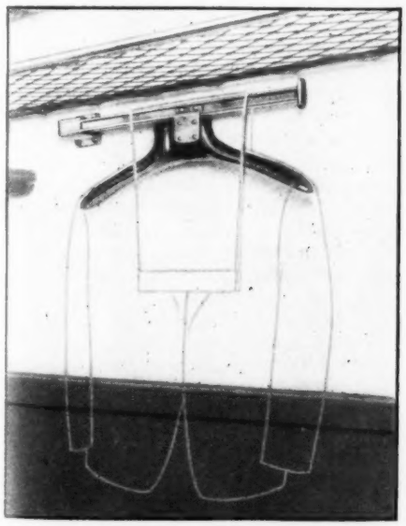
This plane, with revolving wings that drive a current of air beneath the fuselage, is expected to hover in the air like an insect. At right, the plane as it will look when in flight

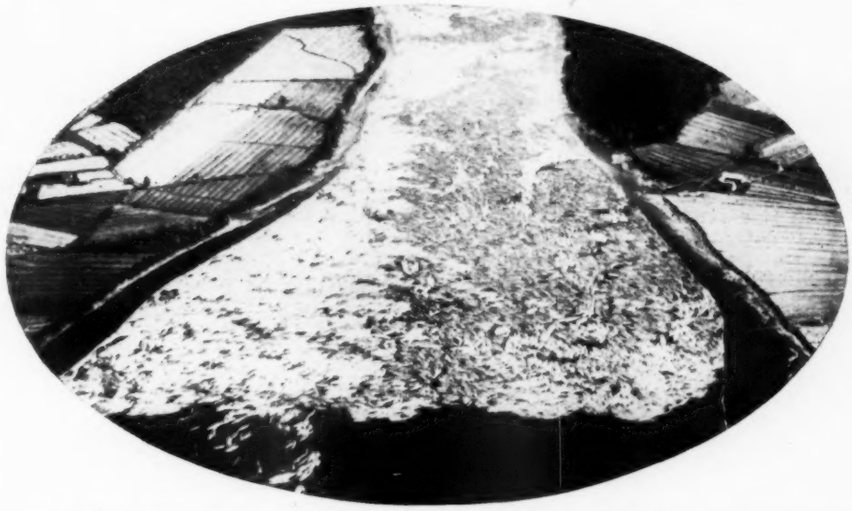
Insect Plane Designed to Hover in the Air

INCORPORATING radical new principles of flight, one of the strangest airplanes yet built is being tuned up by its English inventor for a trial ascent. It is known as the insect plane and it is expected it will be able to hover in the air as an insect does. This is to be accomplished, the inventor says, by motor-driven rotating wings attached at right angles to each side of the shedlike fuselage. The revolving wings, each consisting of three vanes, will provide the necessary lift.

TRAVELER'S SUIT HANGER KEEPS TROUSERS HANDY

A NEW combination suit-and-trouser hanger, recently put in use in sleeping cars by an English railway, makes it possible for a male passenger to get his trousers on or off the hanger without disturbing his coat and vest. The designer recognized that trousers are taken off last at night and put on first in the morning.





LOGS IN CANAL LOOK LIKE BIG GLACIER

SUMMER or winter, the Millykoski Canal in Finland has its glacier. The illusion, striking when viewed from the air, is formed by millions of logs floating down the canal, from the richest forests in the country, to the giant sawmills that line the canal. Skimming over the canal in a low-flying plane, a photographer snapped the remarkable picture of the slowly moving mass of logs, that is reproduced above, thus making a permanent record of the unusual scene.

MOVING LIGHT ON CAR SIGNALS FOR A TURN

A SPOT of light travels from left to right or in the reverse direction to show which way a motorist is about to turn, in a new electric signal introduced in France. As in animated electric signs used for advertising purposes, the effect is produced by a rotating contact that causes each of a row of lamps, shown at right, to be flashed on momentarily in turn. A steering wheel switch sets the signal in action, and its moving light is easily seen.

AUTO KEYS COLORED

BRIGHT colors applied to a new type of automobile key make it possible to select instantly the right key for a particular lock. The ignition and door key is red, the trunk or deck key blue and the tire key yellow. Color is applied by an electrolytic process. The keys are made of aluminum alloy and three of them weigh no more than one ordinary key and are said to be equally as durable.

EXPERIMENTS *with* STEEL BALLS AND MAGNET *show How the Planets were Born*

Illustration shows how the attractive power of a gigantic visiting sun raised tidal waves on opposite sides of the sun and drew them out so far that they began to revolve in orbits around the sun

AS YOU look up into the star-lit sky and realize that every point of twinkling light is a sun, your imagination may picture thousands of solar systems like our own with tens of thousands of worlds circling round their suns.

This is a fascinating speculation, but modern astronomers believe it probably has little foundation in fact. Their present hypothesis says that our solar system is the result of an accident so rare that it may never have occurred before in our universe. This accident was the near-collision of two suns, our own and a wanderer.

The story of what happened when these two gigantic, white-hot globes passed each other is today the generally accepted story of creation, as far as our earth and its sister planets are concerned.

As the wanderer approached our sun nearer and nearer, the intruder's gravitational attraction began to raise great tides in the fluid substance of our luminary, just as the moon now raises tides in our earth's oceans.

But the tides raised on our sun by the approaching visitor's pull were not a matter of a few feet. The sun's ocean of fiery matter was pulled up into a prominence millions of miles high.

Nearer and nearer rushed the intruding sun, and higher and higher rose the attracted prominence, until, at the visitor's point of nearest approach, the drawn-out matter was completely torn off from our sun and floated in space as a flaming streamer.

From this pulled-out streamer the planets of our system were gradually formed and condensed.

The process by which this creative accident may have taken place can be vividly illustrated with a few dozen small steel balls, such as are used in ball bearings, and a simple bar magnet. The freely rolling mass of tiny steel balls can be made to represent the flowing, fluid matter in our sun and the bar magnet can represent the gravitational force of the wandering star.

To represent the sun in this way, the writer took a little cellophane from a cigarette package and folded up a strip of it, several folds thick and about an eighth of an inch wide. This was then curved between the fingers and cemented to the glass in a large photographic printing frame. A small gate, slightly wider than one of the steel balls, was left in the wall of the ring stuck to the glass.

When this little corral, about the size of a twenty-five-cent piece, was cemented to the glass, and fully dry, I filled it with the small steel balls. This cellophane ring, retaining the balls, thus represented our primeval sun before it had any planets circling about it.

I was now ready for the approach of the wandering sun which was to produce the cosmic accident from which it is believed our system developed. I let this visiting sun, or rather its gravitational force, be represented by a good-sized bar magnet. Holding this magnet in my hand, I moved it nearer and nearer to the little corral of steel balls, representing our sun.

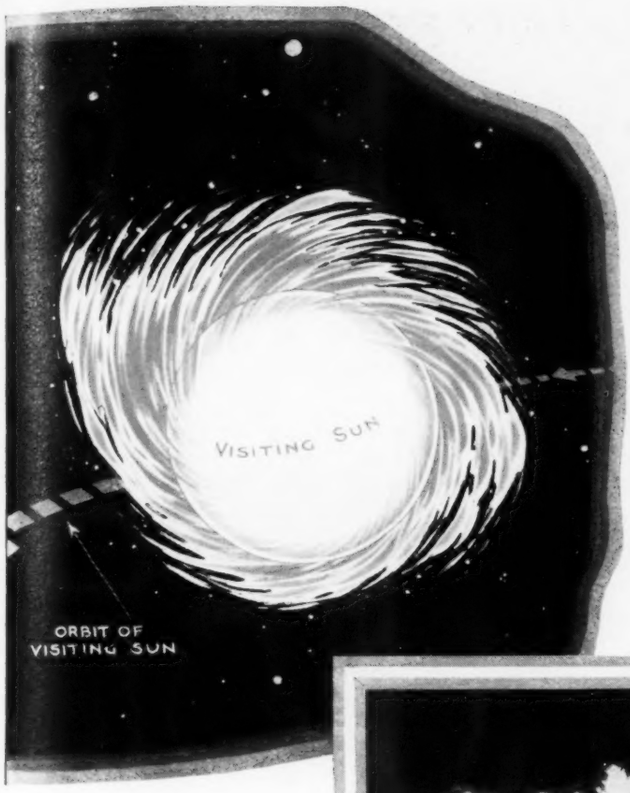
When the magnet came directly opposite the gate in the cellophane wall, the balls were drawn out of the gate in a row, one sticking to the magnet and each following ball sticking to the one before it. As the magnet moved on, the streamer became curved—in other words, its revolution around the sun was started.

How the Planets Were Born

Representing the sun is a ring of cellophane enclosing steel balls. A bar magnet is used to serve as the strange sun that invaded our universe. The illustrations show how, as the magnet approaches the balls, they are drawn through an opening in the ring exactly as matter may have been drawn out of the sun by the visiting star. The present theory says that this streamer of gaseous material torn from the sun gradually solidified to form the planets

Unique Cosmic Accident, Caused by the Intrusion of Giant Star, Made Possible Our Solar System

By GAYLORD JOHNSON



Below, flaming prominences shooting out from the surface of the sun. These sometimes reach a height of more than 300,000 miles above the sun

Crude as this apparatus is, it serves to illustrate vividly how the streamer of planet-forming matter was drawn out of our sun by the pull of the wandering luminary which had intruded upon our privacy.

To form an idea of just how large the space is which a sun has at its disposal, imagine a single speck of dust hanging by itself at the center of a big railway terminal. This represents the condition in the crowded part of space embraced in our galaxy or Milky Way. In the less crowded parts, the grains of dust would be several miles apart.

It isn't surprising that collisions, or near-collisions, such as the one which astronomers think gave rise to our streamer of planet-forming material, are rare events. They are about as likely as a collision between a single intruding grain of dust with the single, isolated grain of dust suspended at the center of the railroad station.

But once the wanderer arrived in the neighborhood of our sun, the ejection of a stream of planetesimal material from it was easily caused.

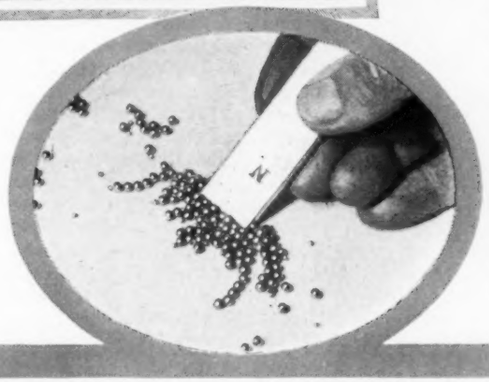
Pictures taken during an eclipse show great flaming prominences extending from the sun outward into space. These prominences can be seen not only during eclipses but at any time through a spectroscope attached to a telescope. Since they are sometimes ejected to a height of over a quarter of a million miles, it is easy to see how the powerful attraction of a visiting sun could extend one or more of them into a stream of matter several million miles long. This streamer, once it had begun to rotate around the sun, would not be drawn back into it. Being of uniform density, this streamer would tend to condense itself around a number of centers.

At first these masses, produced by condensation, tended to be uniform in size. They were formed out of the gaseous substance, just as rain drops are condensed out of a vaporous cloud.

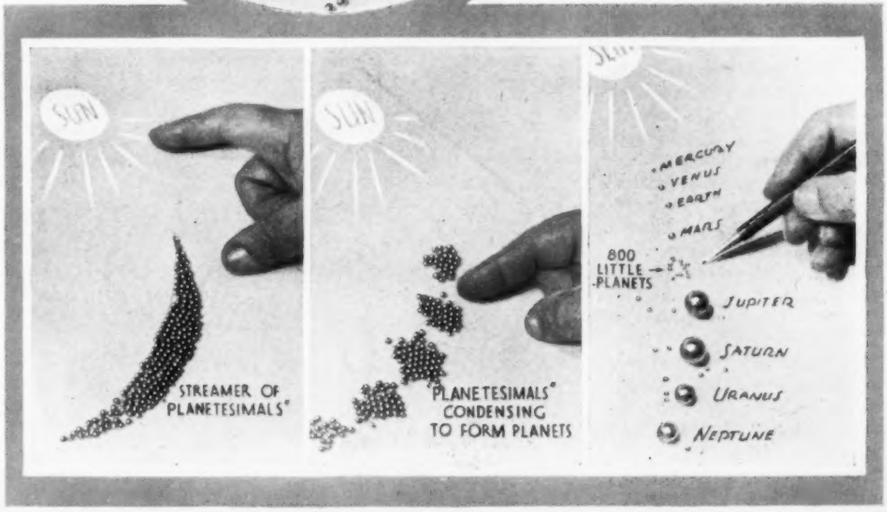
But soon the mutual gravitation combined and condensed the planetesimals (miniature microscopic planets) around a few well-defined centers.

The final, or rather the present, stage of the process is crudely represented by the steel balls of graduated sizes shown in one of the illustrations. There the individual rain drops, or planetesimals, are shown after they have combined repeatedly to form large and solid hail stones, or planets. Notice how the larger planets, also having the largest number of moons, were formed near the center of the primitive streamer, where planet-forming matter was most abundant. Also notice that the space between Mars and Jupiter is occupied by a swarm of small planets, or asteroids.

It is supposed that the conflicting attraction of the sun and Jupiter has prevented this ring of the original planetesimals from getting together to form a single large body at this point in the solar system.



Left, when a bar magnet is moved across a field of steel balls, they are drawn into one mass. In this way, it is believed, the force of gravity swept together the particles in the streamers torn from the sun and so formed the planets. Below, at left the streamer represented by steel balls evenly distributed. Next, the balls gathering around a central nucleus. Last, the balls solidified into masses representing earth and planets



Torpedo-Shaped Boat Speeds on Hidden Fin

A STREAMLINED, torpedo-shaped motorboat that is expected to set new speed records has been completed by boys of the Rocky River High School, Cleveland, Ohio. In working out the design for their odd boat, they incorporated the hydrofoil principle introduced not long ago by Dr. Oskar G. Tietjens, Westinghouse research engineer (P.S.M., Oct., '33, p. 26). This comprises a transverse fin or plane beneath the boat, on which it glides as it reaches full speed. As a result the fifteen-foot speedster skims the surface like a water insect, with little friction.

Above, torpedo-shaped boat built by Cleveland high school boys. Right, young mechanics at work on boat. The transverse fin can be seen

TINY POCKET WIND GAGE DESIGNED FOR AVIATORS

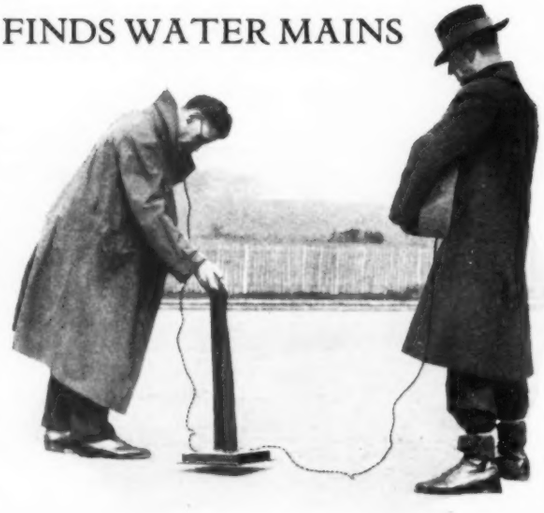
SMALL enough to be slipped into a pocket, an aviator's hand gage for measuring wind velocity has been developed in Russia. Its dial is no larger than a watch face and the shaft supporting the whirling wind cups extends only a few inches above the instrument, shown below.

MECHANICAL BOOKMARK KEEPS YOUR PLACE

WHENEVER you lay down your book, a compact little device, recently placed on the market, automatically keeps your place. The mechanical bookmark consists of a clamp that is attached to a book, and a thin wire marker held by a spring. As a page is turned, the marker snaps into place upon the new leaf. Its operation is illustrated at right, the upper view showing it while the book is being read and the lower picture with the book closed and the wire marker in place.

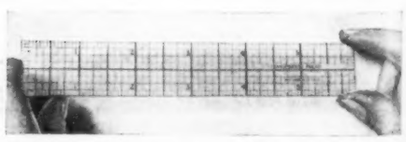
DIVINING ROD FINDS WATER MAINS

WATER mains accidentally lost when old landmarks were destroyed for the construction of roads and new buildings are being found in England with the assistance of a recently developed divining rod. The rod is a shallow square box connected by wires with a battery and telephone receiver. Current passing from battery to receiver is affected when the box is placed above buried metal, as at right, and the result is an audible signal. Engineers by this means can trace the course of the old mains.

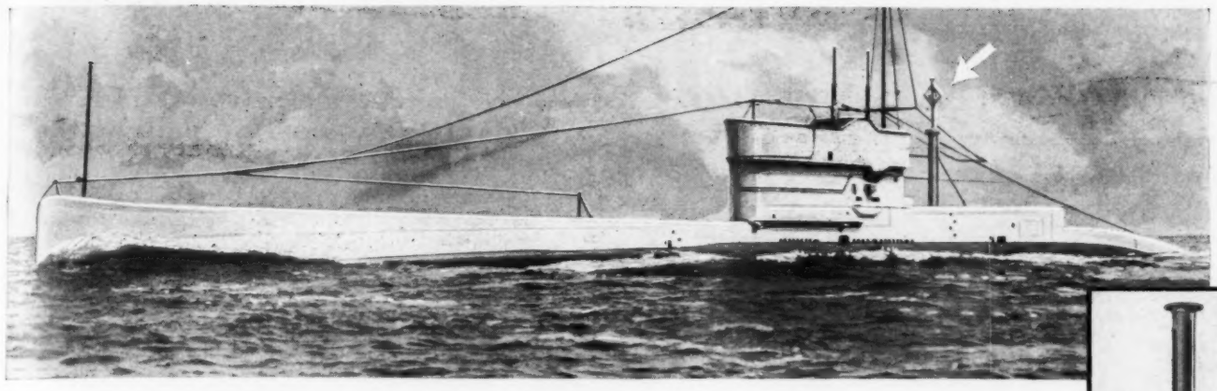


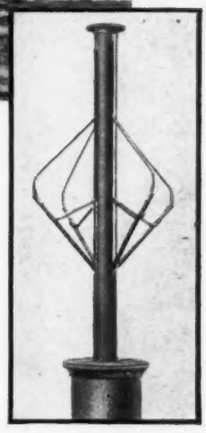
TRANSPARENT RULER AIDS DRAWING OF FIGURES

A FLEXIBLE, transparent ruler, said to be the only one of its kind in the United States, is shown in the photograph below. It is divided into one-eighth- and one-sixteenth-inch squares so that margins, oblongs, squares, and scales for music may be made without dots. Curved lines may be made by using the ruler edgewise.



Squares, oblongs, and curves may be drawn with ease by means of this flexible, transparent ruler





Above, arrow points to the tubes that contains the aerial mast designed to assist submerged submarines in taking their bearings. At right, close-up of the aerial showing its loops extended

RADIO AERIAL GUIDES SUBMARINE UNDER WATER

SUBMARINES, equipped with a newly developed telescopic aerial just adopted by the British navy, may receive radio direction beams even when submerged. Ordinarily, submarines are deaf as well as blind when they dive, and when they rise to the surface in darkness or fog their position can be determined only by dead reckoning. With the new aerial, bearings may be taken, while submerged, with the aid of any known beam station. The aerial does not interfere with the under-water navigation of the submarine and the device is said to be as nearly accurate as any radio compass on a surface steamer. The mast bearing the aerial is set in a tube permanently fixed to the hull just aft the conning tower. When needed, the mast is pushed upward through the tube. Operating gears are inside the tube.

MAN, WEARING AN ASBESTOS SUIT, SAFE FROM FLAMES

WEARING a new asbestos suit recently tested at Slough, England, a man may walk through the fiercest flames without the slightest danger of being burned. The fireproof suit consists of a main garment covering the body and limbs in the manner of a mechanic's jumper suit, heavy shoes and mittens, and a cylindrical mask with a long valance, as is shown in the photograph above. During the tests, a man wearing the suit entered a flaming and smoke-filled building, recovered heavy objects, and emerged unscathed, it is said, from the unusual and severe ordeal.

TOY PUTS MOVING COMICS IN HOME

ANIMATED cartoons for the play room are provided by a new comic-strip projecting toy. Films used in the device bear four drawings of an object in different positions. There is a separate light behind each figure and the child operator can light these bulbs alternately by moving a pencil-like contact over four contact points. The images flashing alternately upon the miniature screen give an amusing illusion of motion. Current for the projector is furnished by two flash-light batteries. Each film has four illustrations of a subject and when flashed on the screen they are highly realistic and delight the children.

Projection toy which, by means of alternatingly flashing lights, throws moving comic strips on screen

NEW CAMERA GIVES DEPTH TO PICTURE

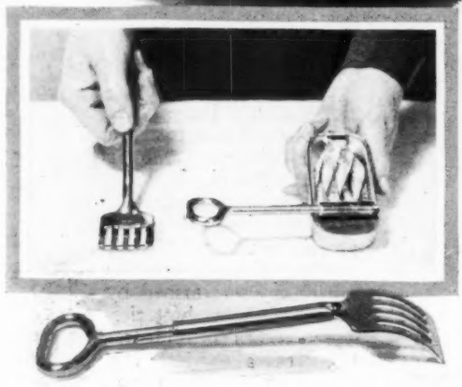
Camera, left above, enables any one to take pictures that, when exhibited in the stereopticon, seen at upper right, will possess lifelike depth

STEREOSCOPIC pictures, possessing lifelike depth, can be snapped by anyone with an inexpensive camera that has recently been placed on the market. The camera is composed of two separate units clamped together, their shutters being operated by a single lever. The prints are inserted in special die-cut cards and observed by means of a viewing rack equipped with magnifying lenses. Prints must be transposed for exhibition, and by means of identifying marks on film and print this can be done easily.

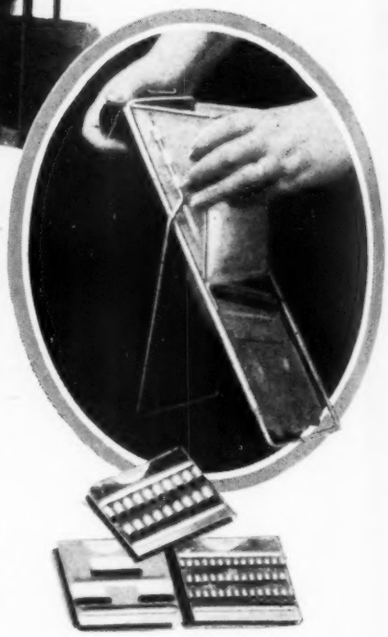
Helpful New Tools

GLOW LAMPS FOR HOME. Patterned after the luminous tubes hitherto used in advertising signs, a new neon light has now been adapted for home use. A soft bluish-white light is produced. Ordinary house current is used to operate the lamp

BATHTUB ON A SLANT. The outline of this tub is square, but the actual tub is diagonal so two wide corners are left that provide seats and racks for soap and sponge. The new shape of the tub is said to make it less dangerous



CAN OPENER IN HANDLE. This useful tool can be used not only as a sardine server, but in its handle there is a can opener with which a sardine can is easily opened. The fork then expedites removal of the fish

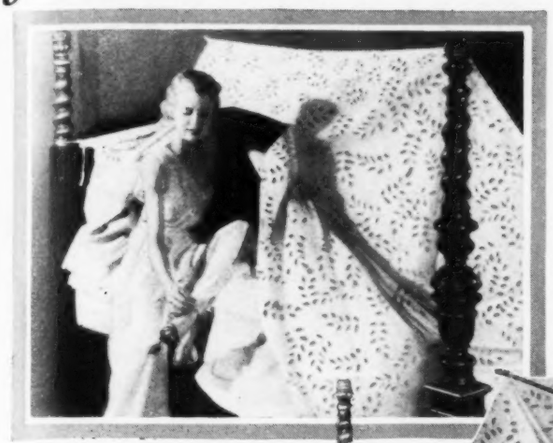


TELESCOPING TRAY. The tray shown above and at right, is adjustable to any size drawer and can be used to keep the kitchen utensils in order. Made of metal, it is of sturdy construction.

VEGETABLE SLICER No danger of cutting the fingers is run when using this vegetable slicer. The food is placed in the sliding hopper and as this is moved up and down a blade on the stationary section does the slicing. Four different blades for coarse and fine work are provided

GLOBE ASH TRAY. Bad odors and fire hazards are eliminated when the globe ash tray, left, is used as it puts out each finished cigarette with a drop of water

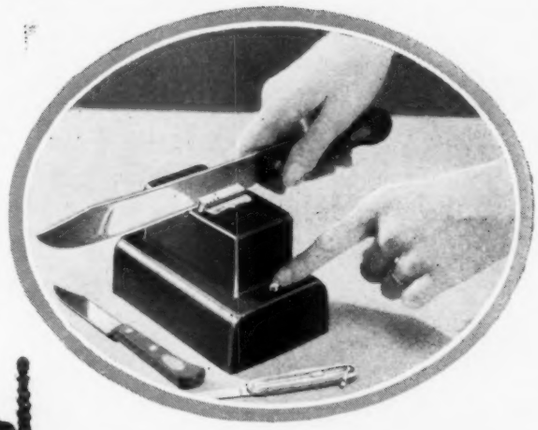
for the HOUSEHOLD •

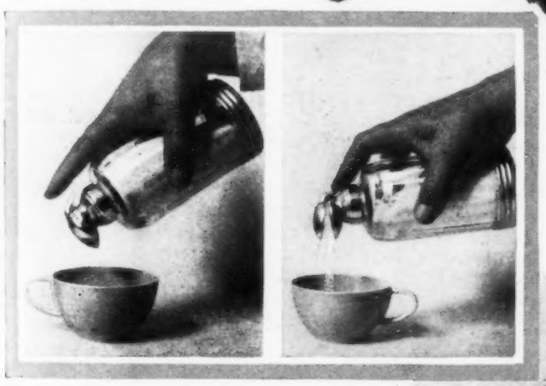


AIR CONDITIONER FOR BED. Comfort on the hottest of nights is assured by a portable air conditioner designed for the bedroom. An electric refrigerating system, housed in a compact unit, supplies a gentle circulation of cooled and dried air inside the tentlike canopy shown above. Cooling unit, right, can be rolled away when not in use

KNIFE SHARPENER RUNS BY ELECTRICITY

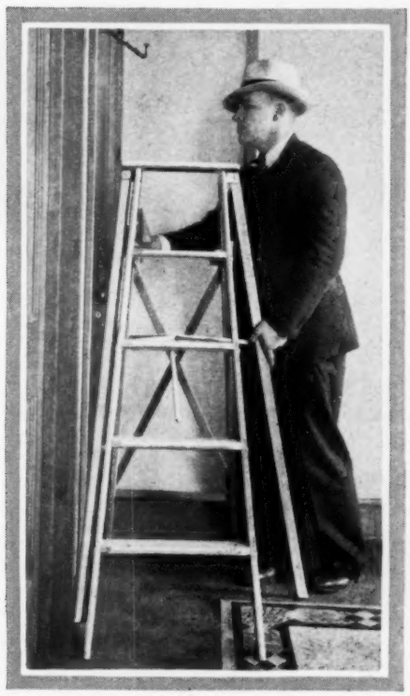
Cutlery is given a keen edge by this electrically operated sharpener. Four flash-light battery cells supply power. The grinding edges are set in motion by pressure of a finger on a button switch, as shown in photograph at the right





SANITARY MEASURING CAP

By means of this ingenious cap, contents of a bottle or jar can be dispensed in fixed amount without using a spoon or removing the cap. Bottle is inverted, as above, and returned to horizontal before opening, as shown at right

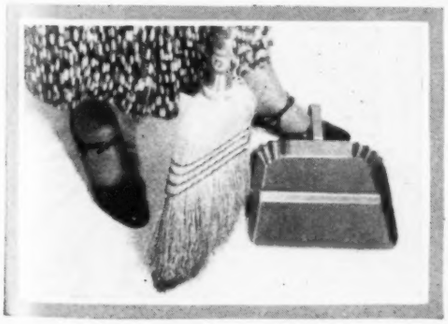


SIX-LEGGED STEPLADDER. Two extra legs are attached to this stepladder and braced with metal rods. By this means, it is said, the ladder is practically proof against falling over

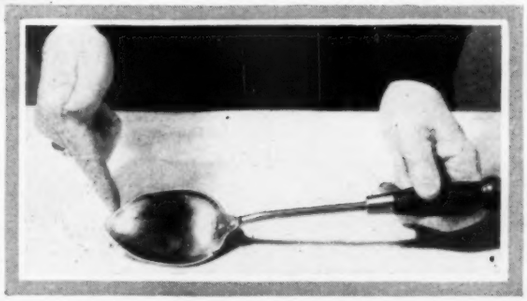
FOOT WORKS DUST PAN

Stooping over to move a dust pan is unnecessary when the foot-operated one, shown below, is used. By holding the pan with the foot, hands are left free to use the broom

VERSATILE SPOON. The angle end on the spoon, below, lies level with the surface and so makes it easy to remove all the sauce that remains in cooking vessel

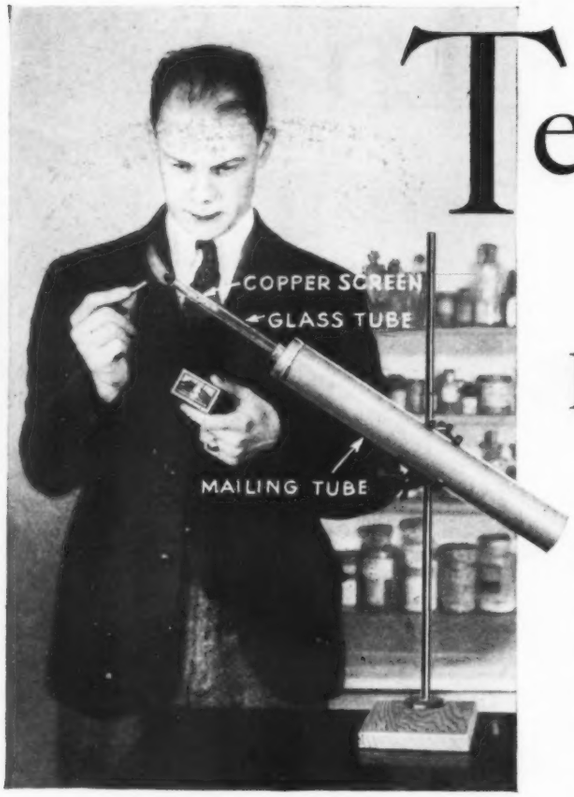


FRAMELESS SCREENS FOR WINDOWS. Installed or removed in a jiffy, the demountable screen seen above is said to be insect-proof. Placed over screws at top and bottom of the window, the wire cloth is drawn taut by lock at bottom



Tests *with* FIRE and AIR

For Your Laboratory



Illuminating gas held in the large container is lighted at the end of the glass tube. As it mixes with oxygen, it burns until it reaches the copper screen and then goes out

By RAYMOND B. WAILES

EXPERIMENTS with air form an inexpensive pastime for the home laboratory. Air is easily obtained, costs nothing, and can be used in hundreds of fascinating tests that require only the simplest of apparatus.

For instance, with an ordinary eight-ounce nursing bottle, a cork, and a few inexpensive chemicals, the home experimenter can measure the amount of oxygen in the air. All that is necessary is to place oxygen-absorbing chemicals in the bottle, shake the bottle, and then hold its neck under water as the cork is removed.

To begin the experiment, place enough pyrogallic acid in the bottle to bring the level of the liquid up to the eight ounce graduation when the bottle is corked and inverted. This means that only the neck and a small portion of the top of the bottle contain liquid, thus leaving eight ounces of air. Then drop five or six small pieces of solid hydroxide, such as lye, into the pyrogallic acid and quickly replace the cork. The pyrogallic acid should be made by dissolving a teaspoonful of pyrogallic acid crystals in an equal quantity of water.

To mix the chemicals with the air, the bottle must be shaken. At first, the liquid will turn brown but as more and more of the oxygen is absorbed it will get darker and darker until it is almost jet black. At this point, lower the bottle neck into a container of water and carefully loosen the cork. As the water rushes in to take the place of the absorbed oxygen, raise and lower the bottle to keep the inner liquid at the same height as the surrounding water. Finally, carefully read the total volume in ounces on the graduations at the side of the bottle.

If the experiment has been performed carefully, you will find that approximately one and one half ounces of water have entered the bottle. Since the water replaced the absorbed oxygen, this will indicate that eight ounces of air contain one and one half ounces of oxygen or approximately twenty percent by volume.

Although the small amount of caustic (lye) in the bottle will have little or no effect on the skin when it is dispersed through the water in the container, the home chemist can pat his hands with vinegar to neutralize any possible action of the base.

Another simple experiment with air, that demonstrates the important part that oxygen plays in combustion and explosions, can be performed with a mailing tube, a cork or rubber stopper, and a short length of half-inch diameter glass tubing. Mount the mailing tube at an angle of forty-five degrees as shown, fit the glass tube to the upper end by means of the stopper, and leave the lower end open to the air.

The first step is to fill the large cardboard cylinder with illuminating gas. This can be done by applying the rubber hose from your gas burner to the glass tube at the upper end of the cylinder. As the gas enters the system it will push the air out. When pure gas starts to flow from the open end of the tube, close the gas burner and disconnect the rubber tube.

Being lighter than air, the gas then will work its way back through the cylinder and issue from the glass tube. Light this improvised jet and watch the flame carefully. At first, it will burn with a lazy yellow flame, showing that it is unmixed with air. As it burns, however, air will enter the system and mix with the gas and soon the flame will appear to be stronger, and gradually turn to blue.

When the flame becomes sharply defined, showing that the mixture is half air and half gas, it will dart suddenly into the glass tube and burn its way with increasing speed toward the large cylinder. When it finally reaches the mixture inside the mailing tube, a loud "pop" will be heard as the air and gas explode. Since the lower

How Home Chemist Can Measure the Amount of Oxygen in the Air

1 To measure oxygen in the air put pyrogallic acid in graduated bottle until eight ounces of air are left

2 Add several small pieces of solid hydroxide to the acid solution in the bottle and then shake well

3 As the chemicals absorb oxygen, the liquid will turn brown and finally become almost jet black

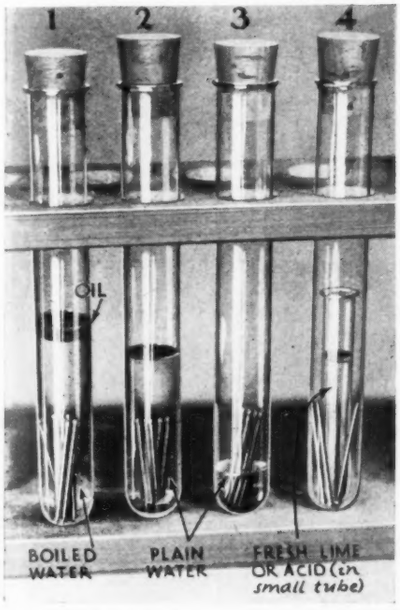
4 Immerse the neck of the bottle as above and loosen the cork. Water will rush in to take the place of the oxygen. The amount of water equals the amount of oxygen the air contained at start of experiment

end of the tube is open, however, and serves as a safety valve, this explosion will not be dangerous.

The initial flame that burns at the tip of the glass tube illustrates ordinary combustion. It is slow and quiet. However, as the percentage of air (oxygen) increases, the combustion becomes more and more rapid until finally it flashes back into the cylinder and burns the mixture almost instantaneously. Thus explosion differs from ordinary burning only in the speed with which the reaction takes place. Combustion is slow burning while an explosion is a rapid combination of the combustible with the oxygen in the air.

This same simple set-up of apparatus also can be used to show the effect of a cooled flame on combustion. The experiment is performed as before, except that a half-inch long wad of ordinary copper screening is pushed halfway through the glass tube.

When the gas is lighted under these conditions. it burns as before until it starts its downward trip through the tube. When it reaches the screening a peculiar thing happens. The metal, dissipating the heat of the flame and conducting it to the surrounding glass, cools the flame below the burning temperature of the mixture and the combustion stops. It is this cooling



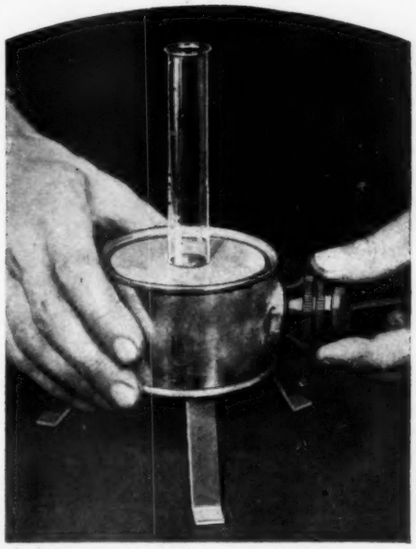
With four test tubes arranged as shown above, in each of which are bright wire nails, you can show that iron will not rust unless it is in the presence of both air and moisture, as both are needed to support oxidation

effect of metal screening that forms the basis of the explosion-proof caps used on breather pipes and vents leading from tanks of gasoline and other inflammable liquids.

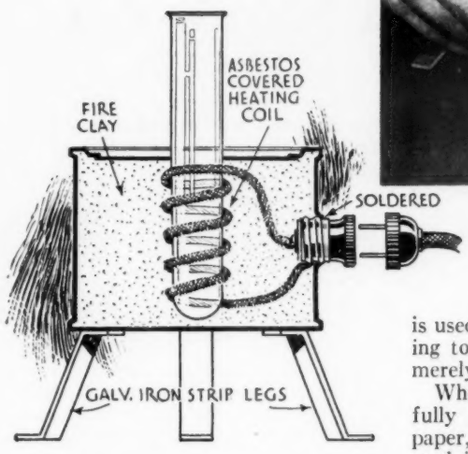
Although when we hear the word combustion we usually think of a flame, it also can be applied to any reaction in which a substance unites with oxygen. The rusting of iron is a good example of this slow combustion. No flame is present but the iron gradually unites with oxygen to form iron oxide better known as iron rust. Iron filings scattered into a flame will burn, but the same reaction will take place if they are merely exposed to the air. The combination will be *(Continued on page 109)*

EASY-TO-MAKE

Electric Heater FOR TEST TUBES



This homemade electric test-tube heater can be made at small cost by following the directions given in the illustration at left



EVEN if your home laboratory boasts a high-grade gas burner, the electric test-tube heater illustrated will prove a useful piece of supplementary equipment. It can be constructed easily and the only expense consists of twenty-five cents for a toy electric iron to furnish the heating element and a few cents for fire clay. The body of the heater is made from a tin can and the legs can be cut from scrap metal.

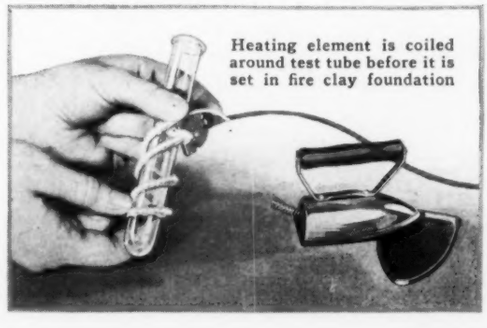
Carefully remove the element from the 110-volt iron and cut about an inch from its length. Connect the two ends to the terminals of a regular screw-type electric plug, either by means of the screws, if the plug is of that type, or by crimping the metal over the wire and applying a bit of soft solder. Then insert the plug in a hole cut in the side of the tin-can heater body and solder it in place. The receptacle end of the plug should project on the outside.

In preparing the body of the heater, first lay a half-inch foundation of fire clay and water mixed to a dough in the bottom of the can. Then wrap several thicknesses of paper around a large test tube, coil the heating element around it as shown, and brace it upright in the center of the can. Finally, pour in the remainder of the clay, bringing it flush with the top of the can. The paper is used to prevent the clay from sticking to the tube. The test tube serves merely as a form for the hole.

When the clay has hardened, carefully remove the test tube and the paper, plug one end of an extension cord into an electrical outlet and the other end into the heater, and allow the clay to season and harden. If, when you try out the heater, you find that a test tube of water becomes coated on the outside with tiny droplets of moisture, it indicates that the clay is not dry and the seasoning and heating should be continued.

As a finishing touch, the heater can be supplied with a switch, wired into the extension cord, and three tripod legs. The legs can be cut from sheet metal and soldered to the bottom of the can. To heat a test tube, simply drop it into the hole and turn on the current. You will be surprised how quickly the job will be done.

If a shallow can having a friction top is used as the body of the heater, a hole to take the test tube can be punched in the top and the top can be pushed into place above the fire clay. This will give the heater a more finished appearance and will protect the fire clay.



Heating element is coiled around test tube before it is set in fire clay foundation

Question: How much heat can a person stand without dying? F. J., Youngstown, O.

Here's *the* Answer

A. TO PUT an end to heated arguments on hot nights, here are the figures: If the temperature of the human body rises much above 107 degrees Fahrenheit, death is almost certain. Normally, however, our perspiration keeps us cool and we can stand temperatures much higher than this. The next time you and your neighbor think it is hot and contemplate the relief of dying, remember that men have worked in Death Valley under a sun that often sends the thermometer skyrocketing to 134 degrees in the shade.

Maybe Newton Knew

Q. WHY IS it that when you drop an apple a soft brown spot appears even though the skin is not broken. I've always thought that the inside meat of an apple had to be exposed to the air before it would rot.—L. C., Bonsteel, S. D.

A.—Up until now, our interest in apples has always waned with the brown spots. Nevertheless what you say about a rotting apple is true. Apple juice contains a colorless chemical. When it is exposed to the air, it unites with the oxygen and forms a new compound that is brown. In the case of a dropped apple, the skin is smashed even though it looks intact. Being porous, it allows the air and oxygen to get inside and the colorless chemical does the rest. So you can chalk your next brown-spotted apple up to chemistry.

Ugly, But Not Deadly

Q. NOT LONG ago I heard two men arguing about the evils and benefits of bread mold. One insisted the mold is harmless and has positive food value while the other maintained that it is deadly. Can you tell me who is right?—E. M. Westport, Pa.

A.—According to medical authorities, no common form of mold is a deadly poison no matter how unappetizing it looks. In fact, strange as it may seem, the same mold that forms on bread often is used to season roquefort cheese. The mold cultures are first grown on bread and then transferred to the cheese when it's ready for ripening.

Inch Measures Gallons

Q. OUT HERE in the dry regions, we don't get much rain so we at least like to talk about it. Just as a matter of curiosity, I'd like to know just how much water falls when there is an official inch of rain?—F. H., Phoenix, Ariz.

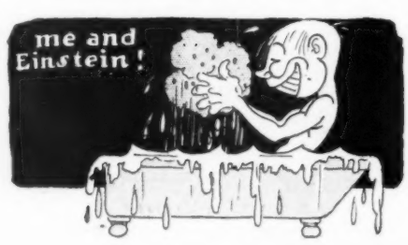
A.—It all depends on how much territory it covers. Approximately 27,000 gallons will fall on every acre of ground. It has been estimated that if the five and one half billion gallons that moisten New York City every time there is an inch of rain could be collected, it would supply New Yorkers with enough bath, cleaning, and drinking water to last five days. Even in your own fair state, that lays claim to being one of the driest in the country, an average of some 200,000 gallons of water fall on every acre each year.

Barbers Were Surgeons

L. K. M., ATLANTA, GA. The origin of the red and white striped barber pole dates back to the early days when surgery was practiced by barbers. The red stripes represent blood while the white stripes symbolize the bandages.

Holes Hold Water

Q. IN EXPERIMENTING with sponges recently, I found that both the rubber and the natural variety will hold more cold water than they will boiling water. Why should this be true? —F. B., New York, N. Y.



A.—Although we've never tried it, what you say about sponges is true. This queer action is laid to the fact that the cold water creates a greater surface tension than hot water. This increases the capillary action and the sponge sucks up more cold water to quench its thirst.

A One-Flypower Motor

Q. WITH ALL of the radio energy that is sent out into the air every day, it seems to me that it could be used as a free source of power. Has anyone ever succeeded in harnessing the power to run a motor?—M. D., Baltimore, Md.

A.—No. Aside from serving to perk a sensitive radio set, there's very little power in a broadcast radio wave. If you were a fly climbing one inch up a vertical wall, you'd use the same amount of power that would be picked up in thirty-five years by a New York station with a one-foot antenna receiving broadcast signals from the largest transmitter in California.

Who's To Be The Victim?

Q. CAN YOU supply me with a simple formula for tear gas? I would like to use it as the basis for an experiment in our high school chemistry laboratory.—A. W., Somerville, Ala.

A.—In the interests of safety, we might answer your query with the one word, "onions." However, "formaldehyde" seems more fitting for a chemistry class.

Simply expose a formaldehyde solution to the air and it will give off enough gas to give your whole class a good cry.

Acid Test for Gold

Q. SINCE THE rise in prices paid for old gold, I've been busy collecting the family's old jewelry. Now that I have it all corralled, I can't separate the brass from the gold. Is there any simple, inexpensive test that I can use to eliminate the brass pieces?—L. P., Phila., Pa.

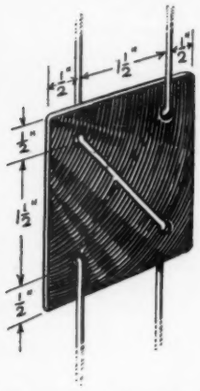
A.—Nitric acid will do the trick, but if you aren't careful it will eliminate the brass entirely. Nitric acid will dissolve brass while it will not attack gold. This same test, by the way, can be used to distinguish platinum from silver. It will dissolve the silver but not the platinum.

Let Sleeping Snakes Lie

Q. A FEW months ago you published an article on snakes and snake venom. Living in *(Continued on page 107)*

Radio Ideas

FOR ALL SET WORKERS



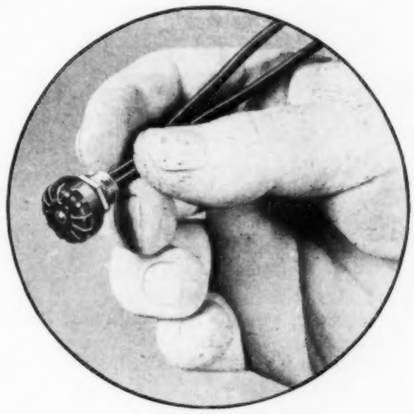
Left, soaking a phonograph record in boiling water so it can be cut up to make insulating blocks. Above, record with lead-in holes

Change Grid Leak

IF THE results you are getting with your home-built short-wave receiver fall short of your expectations, try changing the grid leak value. Although a resistance of one megohm often is specified, a larger unit sometimes will give much better results. A grid leak that will work perfectly in one version of a circuit may prove too small in another. To play safe, keep a supply of one, three, and five megohm resistances on hand and substitute various values in the circuit to find which works best. Many experimenters prefer the variable type of grid leak for this reason since it can be varied to give a large variety of resistance values.—A. S.

Insulators Cut from Phonograph Records

WHEN a doublet short-wave antenna must be placed some distance from the receiver, a large number of insulating blocks will be required for the long transposed lead-in. If ready-made insulators are not available, satisfactory substitutes can be made from old phonograph records. Simply mark out the 2½-in. squares with a pencil or a knife, soak the records in boiling water until they are soft, and then cut them to shape with a pair of sharp scissors. As soon as they are removed from the heat, they will harden and the four ⅛-in. holes can be drilled for the lead-in wires. As is the usual practice with doublet antennas, the insulating transposition blocks should be placed every fifteen inches.—A. W. A.



Miniature Switch Resembles Rosette

RESEMBLING a tiny decorative rosette, the miniature single-pole, single-throw switch shown in the illustration is the latest piece of space-saving equipment available to the amateur set builder. It is sturdily constructed, requires only a single small hole for mounting, and when in place projects only ⅜ in. from the panel. Although designed as a regular on-off switch, its design makes it particularly valuable as a control for supplementary circuits installed in factory-built receivers.

Boosting Filament Transformer Voltage

ALMOST every radio experimenter has at some time or other come to the sad realization that the filament transformer he has on hand fails by half a volt or so to match the requirements of the set he is building. If a toy transformer, of the electric train type, is available, however, this difficulty can be overcome easily without complicated wiring or additional expense. By placing the toy transformer in the primary circuit of the filament unit as shown in the diagram and varying the voltage by means of the adjustable tap switch on the toy transformer, the filament transformer voltage can be stepped up one or two volts.—F. G., W6VR.

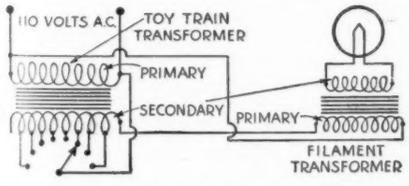


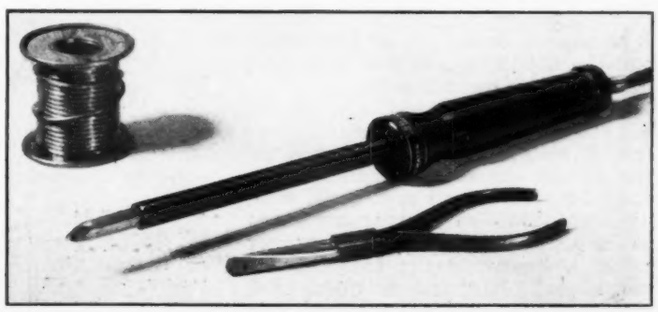
Diagram shows how electric-train transformer can be used to boost filament transformer voltage

Vernier Adjustment

ON A short-wave receiver using the old-style direct-drive tuning dial, a vernier adjustment can be obtained by holding the rubber-tipped end of a lead pencil against the panel and the edge of the dial. Turning it moves the dial.

Novel Soldering Iron

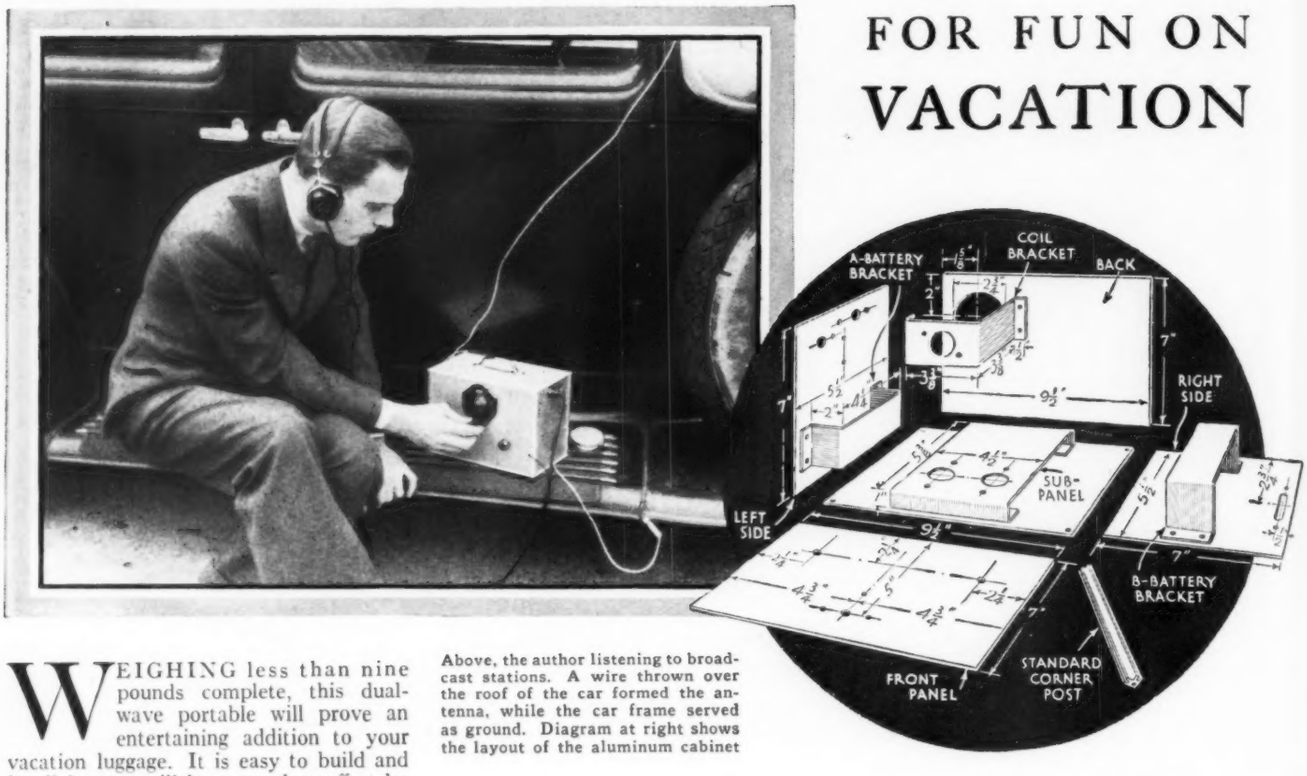
PROVIDED with a special balanced handle, a new type of inexpensive soldering iron requires no space-consuming support to prevent it from scorching your bench top. When rested on any flat surface, the weighted handle automatically lifts the hot tip out of danger. Even if the iron is left on and forgotten, there is little danger of fire since the heated end is suspended far enough away from the bench or table to make burning impossible. Besides this balanced feature, the new iron also boasts an air-cooled handle and an easily removed soldering tip.



Soldering iron with a balanced handle that keeps point from burning the table

Dual-Wave Portable

FOR FUN ON VACATION



Above, the author listening to broadcast stations. A wire thrown over the roof of the car formed the antenna, while the car frame served as ground. Diagram at right shows the layout of the aluminum cabinet

By GEORGE H. WALTZ, JR.

•

WEIGHING less than nine pounds complete, this dual-wave portable will prove an entertaining addition to your vacation luggage. It is easy to build and its slight cost will be more than offset by the hours of radio fun it will bring to you in your car, your canoe, and your summer camp.

Although its durable aluminum cabinet measures only 6 by 7 by 10 in. overall, it houses the entire receiver, including the batteries. In fact, if the head band is eliminated, even the earphones can be neatly stowed away for transportation.

The two-tube circuit, consisting of a screen grid regenerative detector feeding into a lightweight resistance-coupled amplifier, is simplicity itself. Designed to operate with a set of two plug-in coils of commercial manufacture, it will cover the short-wave as well as the broadcast bands from 100 to 550 meters. The parts are easily obtained and, including batteries and tubes, will cost you less than fifteen dollars.

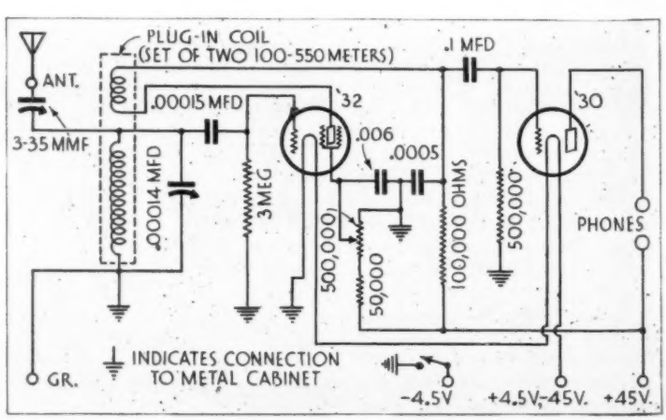
As to the battery supply, a small 45-volt battery of the portable type serves as the B source and an ordinary 4.5-volt C battery feeds the series-connected 2-volt filaments of the type '32 and '30 tubes. The B battery will out-last the summer season and the A battery will give more than fifteen hours of continuous use.

For the broadcast band, the portable will operate with almost any antenna system. In tests near New York City, a few feet of wire thrown at random over the roof of a car was used as an aerial while a wire clipped to the running board served as the ground. Of course, on the shorter waves a longer antenna and a better ground gave better results. Under good conditions the outfit produced sufficient volume on the broadcast band and several amateur phone stations to operate a magnetic speaker.

Although the cabinet can be made by the amateur from sheet aluminum and ready-cut aluminum corner posts, the small amount thus saved will be more than offset by the bother and additional work. Standard shielding cans of just the right size can be purchased assembled and drilled to specifications for only a trifle more than the materials alone would cost. The strap holders for the two batteries, the subpanel, and the coil socket bracket can be bent from sheet aluminum and bolted in place.

To make the operation of the set as simple as possible, a hatch has been provided to allow the plug-in coils to be changed without removing the top of the cabinet. This is merely a 2¾-in. diameter hole cut in the rear of the cabinet and fitted with a standard circular coil-shield cap. Caps of this sort can be obtained from most dealers in radio parts.

ANOTHER smaller hole cut in the left side panel of the cabinet allows the antenna trimmer condenser (3-35 mmf.) to be adjusted easily. A small screw driver or a bone-handled penknife inserted in the hole can be used to turn the small adjusting screw. If desired this set-up can be improved still further by soldering a short brass rod, fitted with a rubber knob, to the head of the adjusting screw so that it projects through the hole. Simply turning the insulated knob will adjust the trimmer plates and no screw driver or penknife



Wiring diagram giving values of the parts. A small 45-volt B battery and a 4.5-volt C battery comprise battery supply

will be necessary. This improved construction is shown in the drawings.

Although a neat subpanel arrangement was used in the original outfit as a mounting for the two tube sockets, fixed resistances, and condensers, it can be eliminated in favor of surface-type sockets mounted directly on the base of the cabinet. This method of construction will be simpler and, in the case of the amateur who may desire to experiment further with the circuit, will provide easier access to the parts and tubes.

AS SHOWN in the photographs, the three main circuit controls are mounted on the front panel. They consist of the .00014 microfarad variable condenser connected across the grid winding of the plug-in coil, the 500,000 ohm potentiometer regeneration control, and a simple on-off filament switch. To give hair-line tuning, the variable condenser was fitted with an inexpensive vernier dial, but this too can be eliminated if cost is an important item.

No great amount of skill is required in wiring the circuit. The specifications of the parts are clearly marked on the wiring diagram. Simply follow the wires one by one, checking each before making the actual soldered connection. A good plan is to connect the series tube filaments first and then proceed with the grid and plate circuits. When wiring the '32 tube, remember that the connection to the grid is through the metal cap at the top of the tube and not through one of the base prongs.

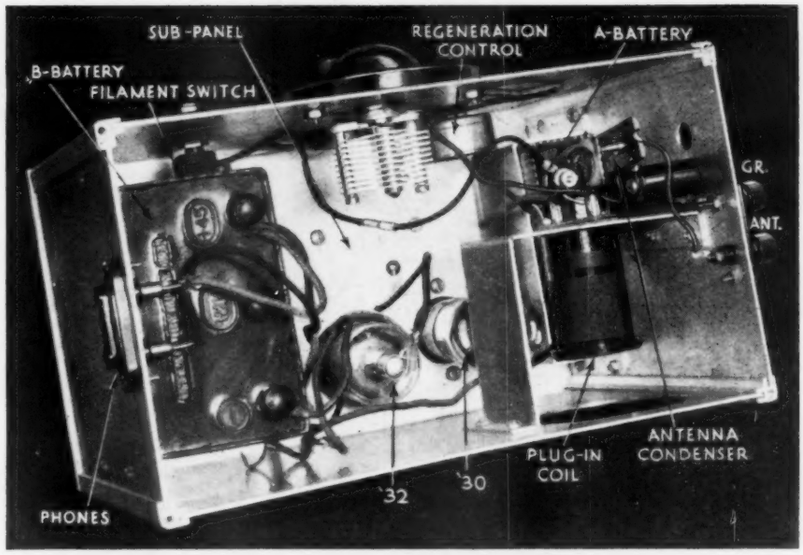
To provide the maximum plate voltage from the single 45-volt B battery, the A and B batteries are connected in series so that the —A lead (to the chassis through the filament switch) serves as the —B lead as well. In this way, a total of 49.5 volts, instead of 45 volts, is available for the plate circuit.

To insure a good ground connection between the various parts of the aluminum cabinet, it will be well to run a separate grounding wire from the sub-panel to one of the condenser dial mounting bolts on the front panel. This will provide a positive electrical contact. Remember, the metal cabinet serves as the -A and -B leads and a continuous connection must be provided if the circuit is to operate.

As in all receivers designed to cover a portion of the short-wave bands, all leads should be short. Too much resistance, especially in the grid circuit, may cause oscillation failure on the higher frequencies. Also when making the tickler connections, be sure that they are not reversed. Trace each winding to verify the four-prong connections on both of the coils.

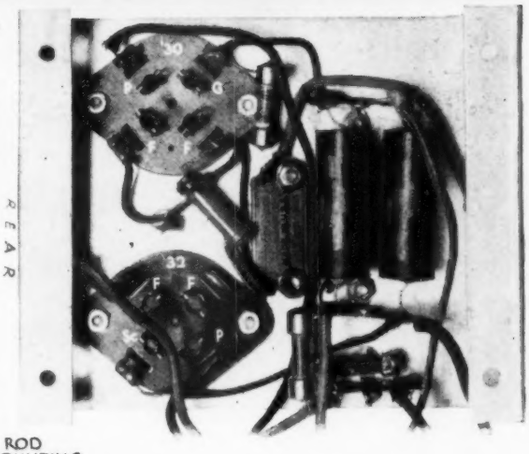
IN OPERATING the set, the tuning condenser and the regeneration resistance are the main controls. However, the trimmer condenser also must be adjusted for each plug-in coil. This can be done by experimenting with each coil. Place the coil in the socket and then turn the trimmer-condenser adjusting screw first one way and then the other for various settings of the tuning dial. On the short waves, you may find that some additional adjustment with many stations will improve reception and increase the sensitivity of the regeneration control.

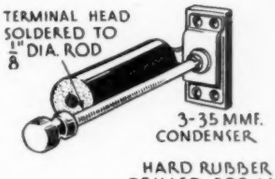
Tune the set slowly. It may take you an hour or so to familiarize yourself with the controls. Unlike most regenerative receivers this particular outfit has proved relatively sharp even on the broadcast waves. If you find that the set, as you have constructed it, fails to oscillate, try various grid leak values.

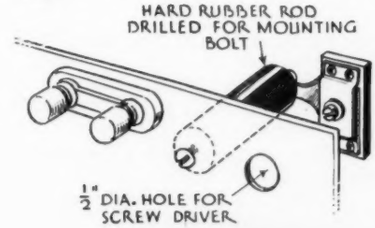


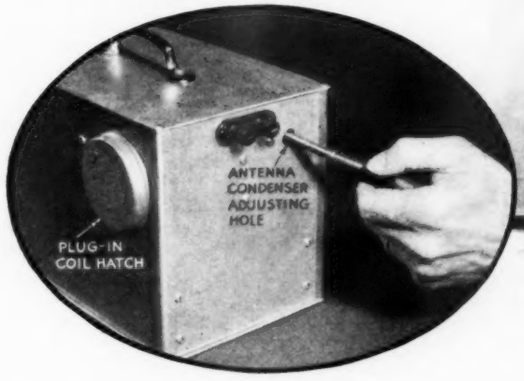
HOW PARTS ARE PLACED IN THE CABINET

Above, top view of the receiver with top removed. Note bracket supporting plug-in coil socket. Right, bottom view of subpanel showing the tube sockets and various fixed resistances and condensers. Below, method of mounting aerial condenser









Plug-in coils can be changed easily, as above. Left, adjusting antenna trimmer condenser through small hole in left side of metal cabinet

Also, in some cases, removing the ground connection from the upper end of the potentiometer will improve reception.

Although no great distance-getting short-wave qualities are claimed for the receiver, it will supply plenty of short-wave thrills down to 100 meters. On the broadcast band, you should have little difficulty logging all of your favorite stations the first time you try. Be patient in building it and operating it and your efforts will be well rewarded.

To assist those readers who may desire to build an exact duplicate of this outfit, a full list of the parts used has been prepared. If you desire this list, send a self-addressed and stamped envelope to the Radio Department, POPULAR SCIENCE MONTHLY, 381 Fourth Avenue, New York, N. Y.

Are Your Headlights Safe?

Gus Tells of Things That Can Burn Out Your Bulbs and What to Do if Stranded in the Dark

BY MARTIN BUNN

Gus drew a picture of the battery circuit in the gravel. "Maybe I can show you," he said, "why your lights went poof"

"WHO'S the mechanic around here?" The gruffness of the voice brought Gus Wilson's head around with a snap. A large sedan had rolled to a stop in the Model Garage driveway. "I am," he replied walking toward it.

"I hope you're better than the rest of them around here," grumbled the driver as he stepped to the ground. "I'll bet I've had this car to four garages in the last two weeks."

"What seems to be the trouble?" inquired Gus courteously.

"If I knew I wouldn't be here," replied the driver. "But I do know that my headlight bulbs and tail light burn out as fast as I put them in."

Gus walked around to the front of the car and patted the head lamps. "Burn out while you're driving?" he asked, casually.

"Yeah, that's what makes it bad. I'll be breezing along when all of a sudden they'll flare up and go out. The thing that gets me is that new bulbs always light when I put them in. That doesn't seem right."

Gus slid into the driver's seat and ran his hand over the rear of the instrument panel. Evidently satisfied with what he found, he pulled up the seat cushion and centered his attention on the battery.

The owner ventured a suggestion. "Do you suppose the generator has anything to do with it?"

"I'll say it has," was Gus's abrupt reply. "But not the way you think. Take a look at this."

He held up the frayed end of one of the battery cables. "Your battery ground wire," he announced, "Your battery looks like it's been loose for some time and in joggling around it's gradually broken the wire in two."

"Then, how come the car started?" demanded the man.

"That's the funny thing about it," said Gus. "As long as the battery stayed still, the two ends of the wire most likely rested against each other and closed the circuit. But every time you hit a big bump, the rebound of the springs tossed the battery up in the air, pulled the two wires apart, and opened the circuit. When she settled back in place again the two wires came together and closed the circuit but if you had the lights on at the time, the damage was done."

The customer looked puzzled. "But I still don't see how a broken battery wire can blow out lights," he argued.

"Maybe I can show you" Gus said as he picked up a short twig and drew a rough picture of the battery circuit in the gravel that bordered the driveway.

"In the first place the generator is connected to the battery, and as long as it stays connected, its voltage can't get any greater than the battery voltage. The current flowing through the battery won't let it. Now, suppose we break the ground connection to the battery," Gus suggested as he smoothed over the gravel to form a break in the line. "That cuts the battery out of the circuit, the generator voltage skyrockets, and poof go your lights.

"As a matter of fact, a loose, dirty connection or a partly broken wire will cause the same trouble. Anything that puts a lot of resistance into the charging circuit will let the generator voltage build up too high. Then, if your lights are on they'll blow out.

"I had a case last winter that showed me what a little resistance in the battery circuit can do. I had just put new headlight bulbs in a customer's car. The next day he came in and said that the new bulbs had burned out the night before. Since I had regulated the generator earlier in the winter, I knew that the charging rate wasn't too high so I had to look somewhere else for the trouble.

"It almost had me stumped until I thought of the battery. It turned out that because of the cold weather, the internal resistance of the battery got a little higher than usual and added just enough resistance to the circuit to shoot the generator voltage up and blow the lights."

As the gray-haired mechanic worked over the battery, replacing the broken wire with a new one, his customer, less grumpy than when he arrived, watched with interest.

"It seems to me," he said, "that manufacturers should supply their cars with some sort of emergency light that could be used when your driving lights burn out. I was in a tight spot the other night. A pitch black road, no lights, and no room to get off the road. I expected to be smashed into any minute."

"Why didn't you turn on the dome light?" asked Gus as he grasped a connecting lug firmly between the jaws of his pliers. "There's no reason why that should have burned out. It wasn't on when your headlights blew."

"Gosh, I never thought of it," the man replied sheepishly.

"There are three things you should do if your lights blow while you're driving," Gus said. "First, jam on your brakes and guide yourself by watching the sky line or the edge of the road until you come to a stop. Second, get as far off the road as you can. And third, switch on your dome light for a danger signal to the rest of the drivers on the road."

"By the way," interrupted the man. "Before I forget it, when you put new bulbs in those headlights will you see if you can do anything to them to make them brighter. Even with new lamps, they seem to be awfully dull."

"It's no wonder," said Gus when he had lifted off the headlight lenses. "Look at those re- *(Continued on page 116)*

THE HOME WORKSHOP

• FIRST OF A GREAT NEW SERIES •

Historic United States Ships

MINIATURE MODELS *for Beginners to Make*

U.S.S. *Saratoga* model made mainly from balsa wood on the scale of 1 in. equals 50 ft. The hull is 18 in. in length, 2 in. wide

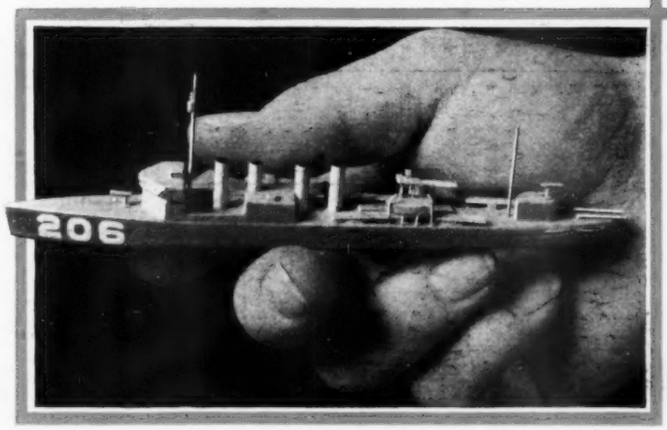
FIRST to popularize ship model making on a national scale, POPULAR SCIENCE MONTHLY now leads the way once more with the most remarkable series of miniature ship models ever designed. These articles, of which this is the first, will make it possible for you to do all of the following:

1. Construct a complete set of miniature models of the most famous warships and commercial vessels in United States history, all to the same scale.
2. Join our new Model-of-the-Month Club for promoting interest in this type of model making. (See the announcement on the following page.)
3. Learn our new system of simplified ship model construction, which makes child's play of what have always been considered difficult tasks. Only a few tools such as a pocketknife, razor blades, pliers, a hammer, and a fret saw are required, and the materials cost little.
4. Save time and expense by getting our special construction kits, which contain all the necessary materials, including colors. A great advantage of using the kits is that they are accompanied by full-size drawings. The materials are of the best quality and are supplied purely as a service to readers, so the prices will be kept as low as possible. For example, you can obtain everything necessary to make

MODEL of the MONTH
Number One

The Aircraft Carrier SARATOGA *and her Destroyer Convoy*

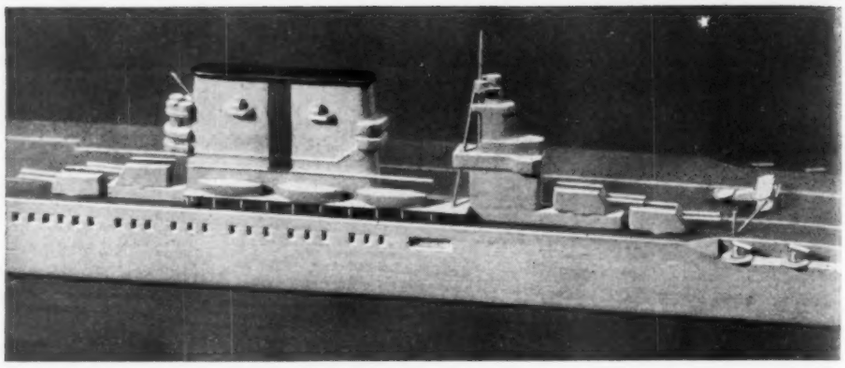
DESIGNED BY
Theodore Gommi



Built to the same scale as the *Saratoga*, this little destroyer model is 6¼ in. long. Construction kits are available for both models. See note at end of article

How to Join Our New MODEL·of·the·MONTH CLUB

Anyone interested in model making is eligible to join the Popular Science Model-of-the-Month Club. There are no dues and no obligations whatever. It is sufficient that you like to make models. An application blank will be found in every one of the Model-of-the-Month Construction Kits (see coupon at end of article). Fill out the application blank, mail it to POPULAR SCIENCE MONTHLY, and you will receive your membership certificate entitling you to all the benefits of the club and allowing you to participate in any exhibitions, contests, and other activities it conducts. Take advantage of this exceptional opportunity at once



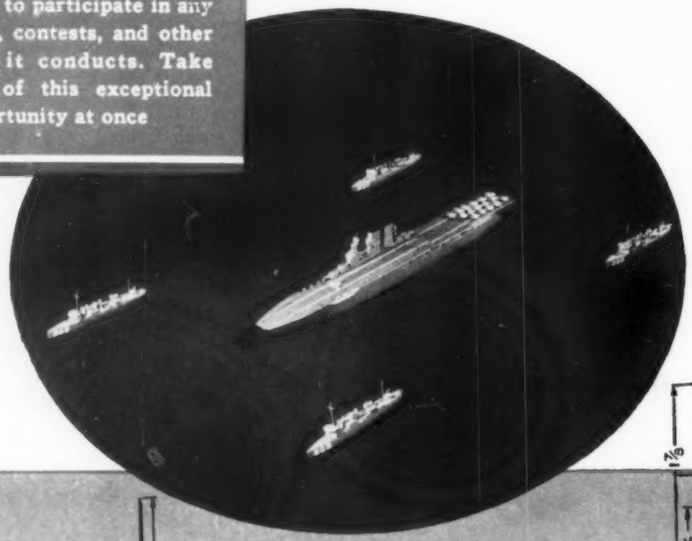
Starboard side view of the superstructure of the *Saratoga*. The anti-aircraft guns at right are ingeniously made from a T-head pin, a tiny eyelet, and a very small washer

the *Saratoga* model, which is 18 in. long, and four destroyer models, each 6¼ in. long—five models altogether—for $1.60. (Use the coupon at the end of this article.)

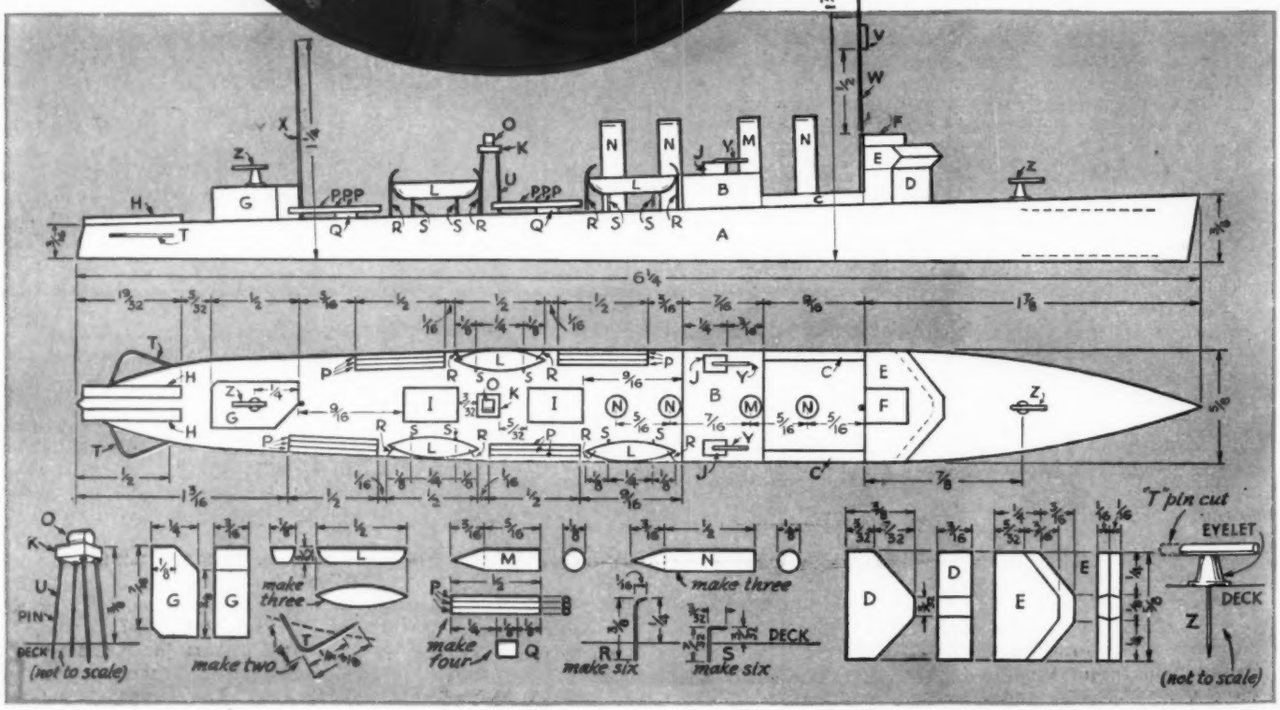
When you get through with this series of scale models, or as many of them as you care to build, you will have a collection that you can exhibit with genuine pride. The models can be used on the mantelshelf, placed in a special display case or in a bookcase, or arranged on the top of a small table. They will attract far more attention than any single model, no matter how elaborate, because they portray in a graphic way the growth of American shipping. For schools, they will form an educational exhibit that cannot be surpassed for its purpose—and something not available elsewhere. That is because the models, although greatly simplified, are authentic and correct. They have been prepared in each case from the original plans of the ship in question or from the best available information. They are so superior in this respect to the designs found in the average cheap ship model construction kits that there is no comparison. These are real scale models, based upon careful research and produced by amazingly simple and ingenious methods of construction.

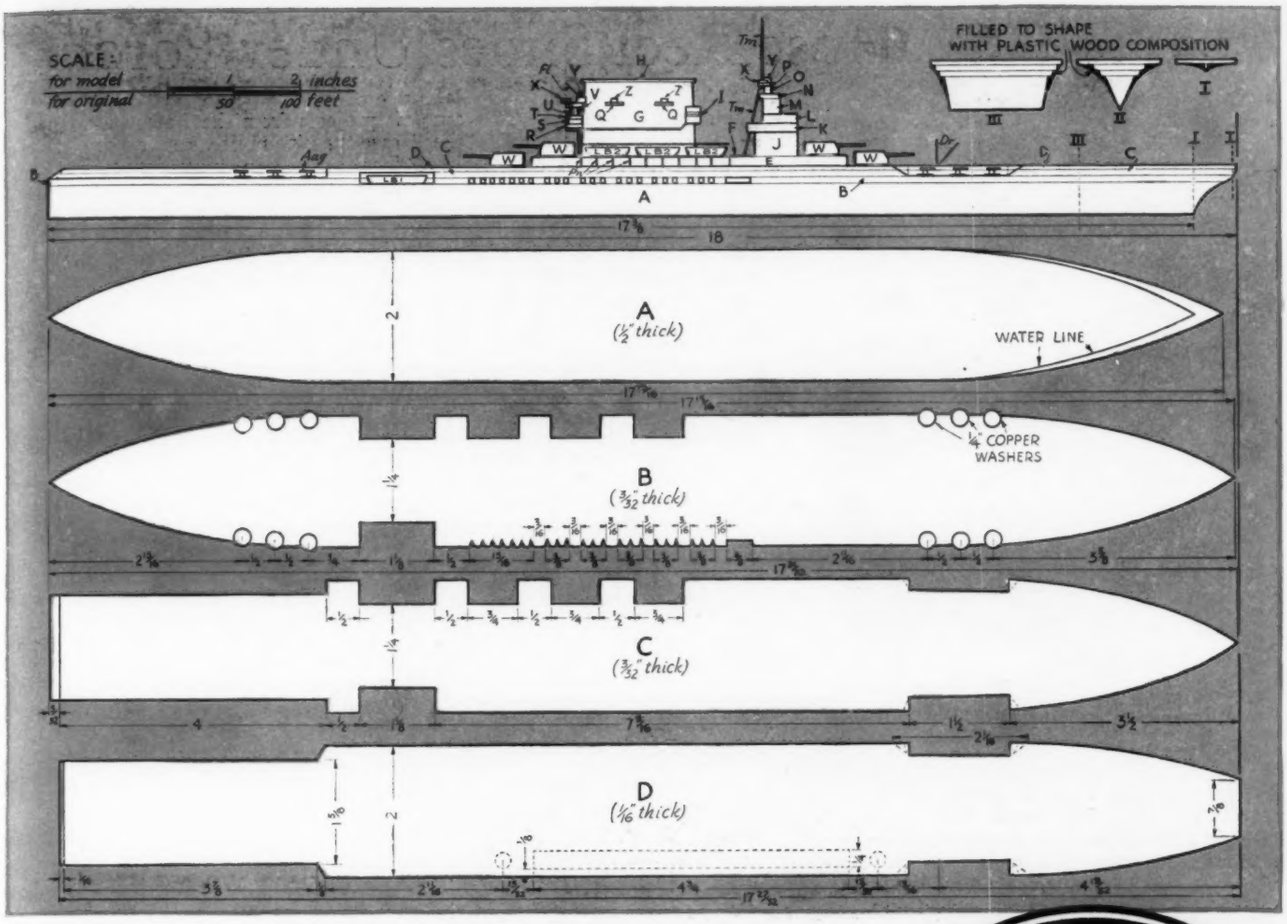
The models are being designed especially for this series by Theodore Gommi, who wrote the article on the *Aquitania* model in last month's issue (P. S. M., July '34, p. 78). He has been collecting plans and data and has been building miniature models for years.

The U. S. S. *Saratoga*, which has been chosen for the first in the model-of-the-month series, is the flagship of the Air-



The *Saratoga* model with convoy of four destroyers. This shows their relative sizes and makes an exhibit that will always attract attention. Below are full-size drawings for the destroyer models





craft Force. The *Lexington* is identical except that it has no identification stripes on turrets and funnel.

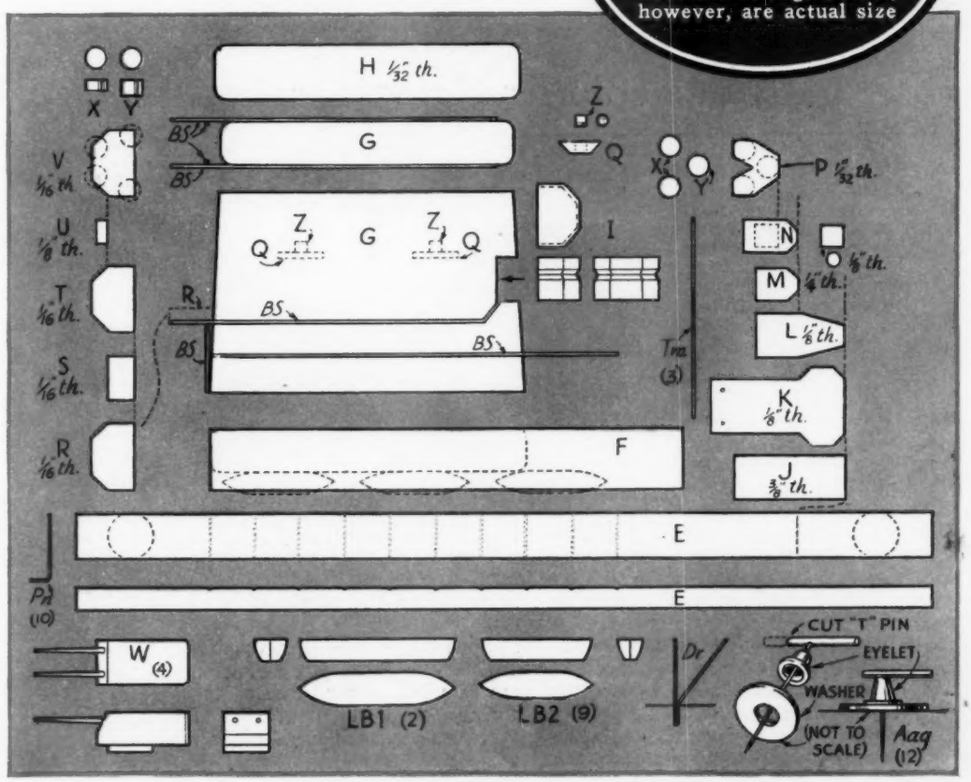
The aircraft carrier, which is the newest of warship types, has now reached a position of great importance. Not only as naval vessels, however, are these ships extraordinary. Their great size, high speed, and unusual features of construction make them triumphs of marine engineering. In the *Saratoga* and *Lexington*, the U. S. Navy has the largest ships of this type in the world. Almost 900 ft. long, with 106 ft. of beam, these giants displace 33,000 tons, yet can travel 33½ knots —four knots faster than the fastest ocean liner afloat. Their enormous hulls contain hangar decks accommodating seventy planes, besides a vast array of sixteen boilers, four 35,200-kilowatt generators, eight 22,500-H.P. motors, nearly a thousand auxiliary motors, and quarters for 1,900 men.

Like all the ship models which will appear in this series, the aircraft carrier is built to the scale of 1 in. equals 50 ft. Following are the step-by-step instructions prepared by Mr. Gommi for both the carrier and her convoy of destroyers. The letters refer to the drawings and list of materials.

Begin by cutting all wood to the sizes specified in the list. Shape pieces *A* to *D* as shown in the plans. Follow the black line in cutting the indentations at the bow of pieces *C* and *D*. Glue *B* to *A*, *C* to *B*, and so on, and press between weights when drying to avoid curling of the thin upper sheets. Cut out *(Continued on page 96)*

U. S. S. *SARATOGA*

The assembly drawings, reduced in size, are given above with an inch scale for ready reference. The detail drawings below, however, are actual size



Automatic Hose Reel Slides Under Porch

Made from odds and ends, this hose reel winds itself up with the aid of a powerful spring. It is then pushed out of sight under the porch

WINDING up the garden hose and putting it away seems such a big job to many people that it is often left out on the lawn overnight. Here is a simple and easily constructed hose reel that is always in place, and it almost winds up the hose by itself. The whole thing slides under the porch when not in use.

Use 2 by 4 in. lumber for framework *J*. The pieces are fastened together with spikes and may be further reënforced with angle braces. For the reel *E*, use a soft-wood to avoid splitting, and assemble with 2-in. wood screws.

The axle, a ¾-in. galvanized pipe, 30 in. long, must be firmly fastened to the framework at one end. This can be done by drilling through the wood and pipe at *A* and driving in a nail.

An old phonograph spring is used to wind up the hose. One large spring will be sufficient for a 35-ft. length of garden hose, but for greater lengths you will need two or even three springs to wind up the hose completely. If you must use more than one spring, mount them on the axle side by side. Wooden strips *B*, nailed to the cross bars, will keep the spring from buckling. Secure the spring to the axle in a manner similar to its original mounting in the phonograph motor. The other end of the spring is looped around a spike at *C*.

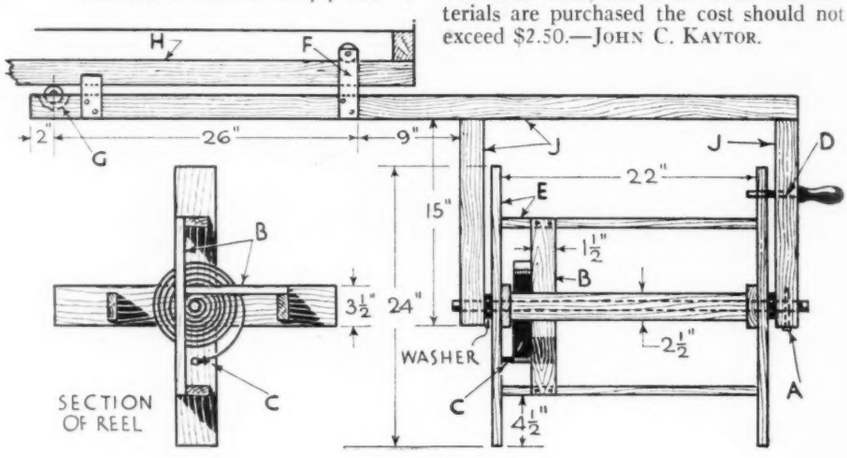
If your garden hose is longer than 75 ft., the spring rewind method becomes impractical and it will be necessary to attach a crank to the end of the pipe where it projects from the framework. In that case the pipe must turn freely in its bearings, and the reel must then be firmly fastened to the axle.

A hole is drilled at *D* to receive a ½ by 7 in. iron rod. This is the locking device that prevents the spring from unwinding when the hose is unfastened from the reel.

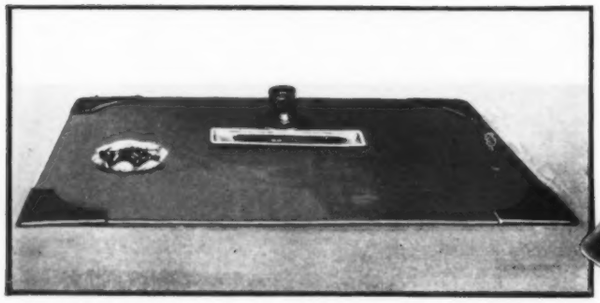
Two pieces of soft steel 1 by 3/16 by 5 in. are drilled and mounted as shown at *F*. Rollers taken from cheap casters are mounted on a 3/16 by 5 in. shaft and supported by the steel pieces. A ¼ by 2 in. metal tube should be slipped on the shaft to separate the two rollers. Gouge out a cavity at *G* to take a single roller, which is mounted on a nail and held in place with staples.

The completed reel is suspended from a two by four *H* that is 70 in. long. This is nailed under the porch in such a way that there will be no obstruction for the rollers.

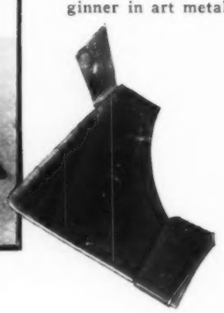
The original reel was built entirely of odds and ends, but even if all the materials are purchased the cost should not exceed $2.50.—JOHN C. KAYTOR.



Individual Blotter Corners Make Desk Pad Unnecessary



This desk set differs from those ordinarily seen in that there is no heavy pad—merely a few blotters with four copper corners



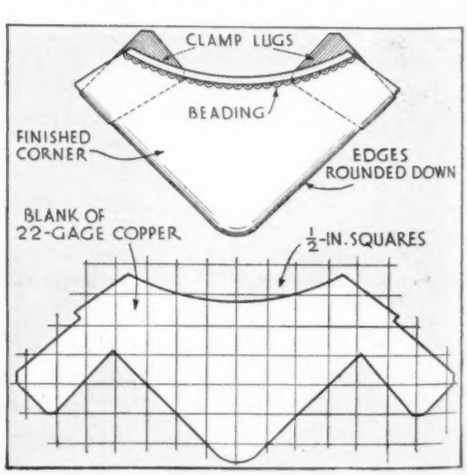
Making these corners is a good problem for a beginner in art metal work

THE hammered copper blotter corners illustrated in the accompanying photographs and drawings are not of the ordinary type, which must be attached to a blotter pad. Indeed, no pad or backing material is required. All that is necessary are two or three desk blotters, over which the corners may be slipped.

From 22-gage soft sheet copper, cut four blanks as shown in the drawing. Hammer one side, and round down the outer edge slightly. The front edges may be beaded or left plain, as preferred. The beading may be done with any sort of punch available with which an attractive bead may be tooled on the metal. It is, of course, a simple matter to make a suitable punch. The lugs, whether decorated in this way or left plain, are then bent under to clamp the corners to the blotters.

Dissolve a small piece of liver of sulphur in about a quart of water, and immerse the finished pieces in this solution until they take on a brownish color. Remove, wash, let dry thoroughly, then polish and lacquer.

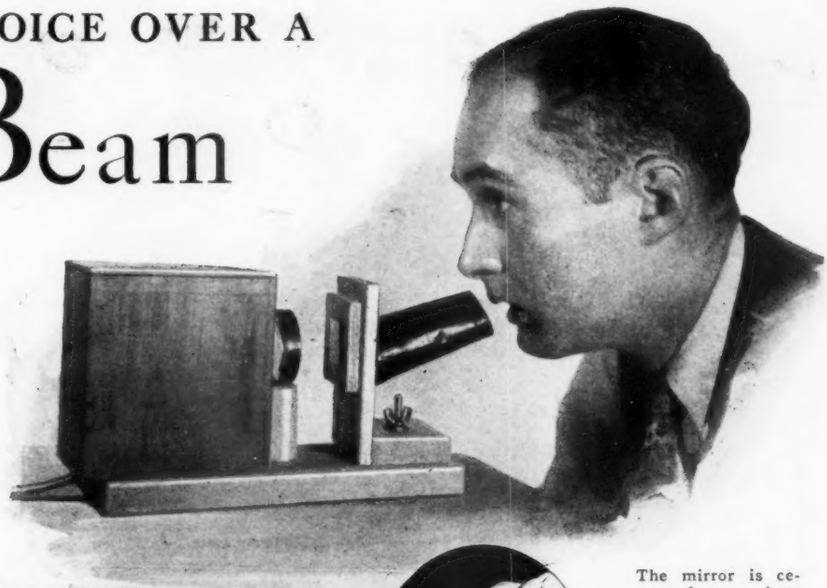
Pieces of thin felt should be glued on the lugs to prevent them from scratching the desk.—DICK HUTCHINSON.



SENDING YOUR VOICE OVER A

Magic Beam *of* Light

By Kenneth Murray



VISITORS to the World's Fair at Chicago will remember the mysterious light beam, passing from one side of a room to another in one of the exhibit buildings, which carried music from a concealed transmitter to a light-sensitive cell mounted on a loudspeaker and amplifying apparatus. Special pick-ups and an electric transmitting cell for an outfit of this kind are beyond the average experimenter, but it is easy to build a simpler type of transmitter, and it can be done at very little cost.

A mirror instead of a bulb-type transmitter is used. A photo-electric cell will serve, with the radio, for a receiver; but again it is possible to simplify by constructing a homemade selenium cell of a supersensitive type. This will be entirely satisfactory for experimental purposes and for the amusement of one's friends. The selenium cell, while very sensitive, is somewhat slower acting than an electric cell, but it performs well with the mirror transmitter.

To make the selenium cell, first cut forty-five strips of shim brass .005 in. thick, 1¼ in. long, and ¼ in. wide. A 1/16-in. portion of one end of each strip is bent over at right angles by means of a slot in the end of a small stick, as shown in one of the illustrations. Cut forty-five pieces of thick mica, 3/16 by 1 in., and sandwich them in between the strips of brass. The latter should be arranged so that the bent ends extend alternately at one side or the other; that is, if one bent end is at the left, the bent ends of the adjacent strips project to the right. The mica strips are kept flush with one edge of the brass strips. This leaves a 1/16-in. space open between the brass strips at the other edge to be filled with selenium. You can then solder wire contacts to the bent ends of the brass strips along each side of the cell. Each wire connects every other strip of brass on each side of the cell, and each strip is insulated from its neighbor by a strip of mica.

Soldering the contacts to the bent-over ends at each side of the cell. *In oval:* Bending the ends

The mirror is cemented to a sheet of very thin metal, which, in turn, is mounted so that it will vibrate to the sound of a voice. Concentrated light from a lamp house is reflected by the mirror and transmits the vibration

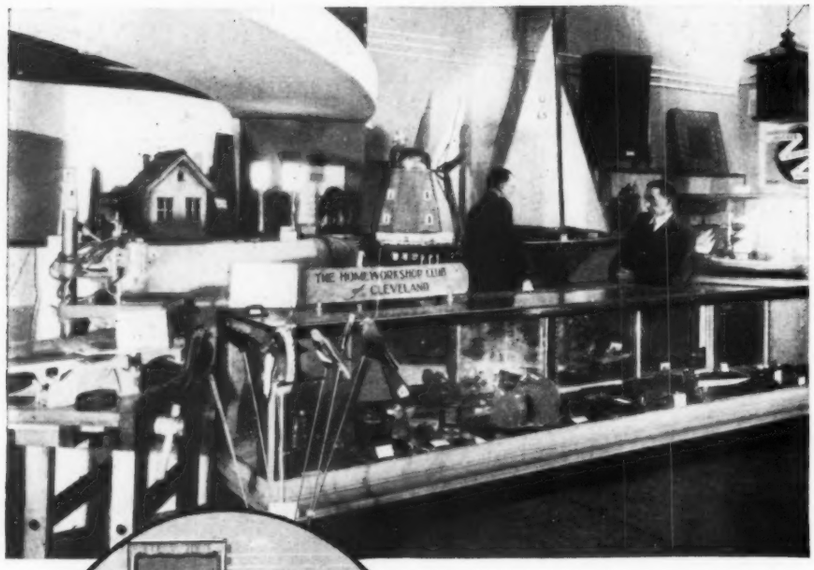
The cell is mounted in a wooden block and melted selenium is forced into spaces between the strips

The mirror-transmitter with dimensions of principal parts

Mount the cell in a wood block, and it is ready for sensitizing. A small stick of metallic selenium can be purchased for a few cents. This is spread smoothly over the surface of the cell and in the open spaces previously mentioned by means of a hot soldering iron. Force the selenium well down into these depressions between each pair of brass strips; this is important. Allow the cell to cool and then gently file down the selenium until the upper edges of all of the brass strips can be seen.

This forms a very sensitive light cell that can be connected directly to the radio in the same manner as you would hook up a "home broadcasting" microphone. You can also attach it directly to the loudspeaker "sound" connections after these have been removed from the radio. Several dry batteries should also be connected in series with the cell when this hookup is used, but allow the power wires to the speaker from the radio to remain con- *(Continued on page 92)*

BLUEPRINTS for Popular Science Monthly projects are listed on page 98.



CLEVELAND CLUB EXHIBITION

A corner of the well-arranged exhibition given by the Homeworkshop Club of Cleveland and, in the oval, a pair of garden gates and other craftwork

Officers of the first junior auxiliary organized by any club in the Guild—the Y. M. C. A. Division of the Topeka Homeworkshop Club. The boys' activities are supervised by members of the Topeka Club

CASH PRIZES *and* TROPHIES *to be given in* Great National

THIS month we are able to announce another great contest for clubs affiliated with the National Homeworkshop Guild.

What we offered last month was to donate to every club having twenty or more members a special sterling silver medal. This is to be awarded in a local competition at the club's annual exhibition next winter to the member whose entry is judged to be the best piece craftwork in the show.

Now we can go further and promise a series of generous cash prizes and valuable trophies to be competed for by all the clubs in one comprehensive national contest. These prizes will be divided into two general classifications. The first group, like the POPULAR SCIENCE MONTHLY medals, will be for the best craftwork of individual members of all the affiliated clubs, judged on a nation-wide scale. The second group will be club prizes awarded, not to individuals, but to the clubs themselves and will be based upon the best club records in respect to growth, club projects, community activities, and general merit.

Plans are now being worked out for conducting this competition in such a way that every club will have an opportunity to participate. The prizes for individual craftwork will be divided into various classifications, such as furniture, decorative metal work, and model making. Each club will hold an elimination contest of its own and forward the best work of its members in each classification to the National Guild Contest Committee.

The committee will arrange an exhibition of these selected projects so that the judges, whose names will be announced later, can compare them and select the prize winners. The awards will be made public at a banquet attended by as many local club members as find it convenient to be present. The exhibition and dinner will be held in whatever city is most centrally located in respect to the national distribution of Guild clubs and will be chosen a little later, when the contest plans are more nearly complete. The time will probably be in the late winter or early spring of next year. All clubs will be kept fully informed of the arrangements in the Guild bulletins.

POPULAR SCIENCE MONTHLY, in providing the large number of silver medals required for the local club contests and bearing the bulk of the administrative expense of the national contest, is doing so in the hope that every club will take ad-

ADVISORY COUNCIL

•

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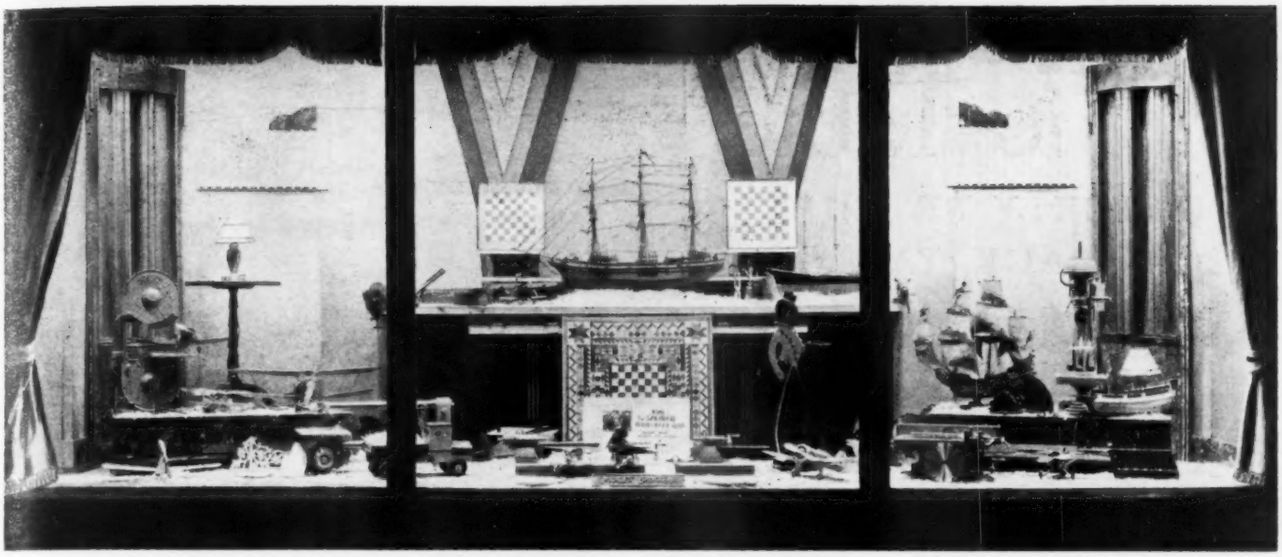


A store-window exhibition of craftwork by the Saginaw Homecraft Club of Saginaw, Mich. Such a display always brings in new members

Home Workshop Contest

vantage of this remarkable opportunity and try for as many of the prizes and trophies as possible. There is nothing like friendly competition to stimulate amateur craftsmen to greater effort. Heretofore this incentive has been almost entirely lacking. The home worker, as a rule, has had no chance to learn what the other fellow is doing and compare results with him. Now the Guild is making this possible in a way, and on a scale, that even the Guild officers did not foresee six months ago.

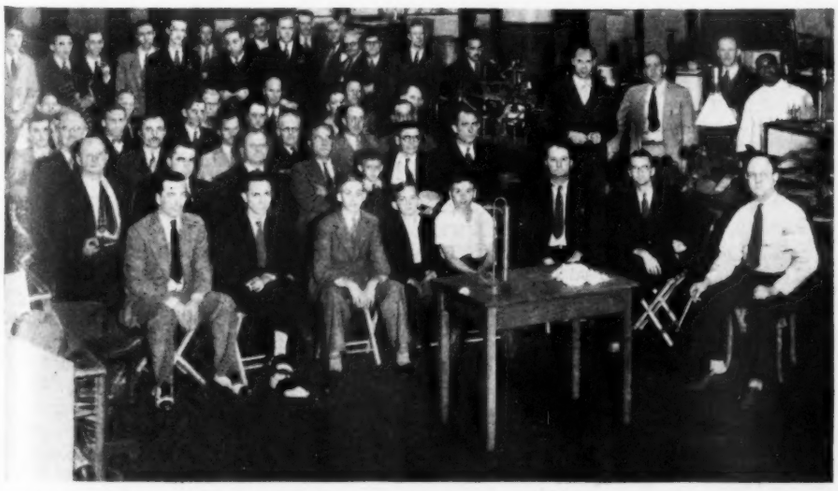
The first thing for every club to do is to make plans to increase its membership as soon as its activities are resumed in the fall. To compete, a club must have twenty members, because the growth of the clubs has been so satisfactory that this is clearly a goal within reach of all the local organizations, no matter in how small a town a club may be located.

Another important preparatory step—and this does not have to wait until fall—is to see that some of the best craftsmen in every club start projects which will reflect credit on the club in the national contest. If a club can carry off any one of the cash prizes or trophies it will be a mark of distinction that will immediately give the club a place of honor in the Guild.

THE POPULAR SCIENCE MEDAL

This is the sterling silver medal bearing the Guild insignia which *Popular Science Monthly* will give to each local club of twenty or more members. The clubs are to award the medals for the best work shown at their annual exhibitions

In their efforts to promote the interests of the local clubs, both the Guild officers and POPULAR SCIENCE MONTHLY are acting with entirely unselfish aims. The annual dues paid by the affiliates of the Guild are sufficient to defray only a part of the expense of administration and promotion. The officers serve without pay, and POPULAR SCIENCE MONTHLY has contributed large sums for printing, mailing, clerical work, and other expenses. This is mentioned only because there have been various unauthorized and unwarranted attempts by outsiders to use the Guild to further their own business interests. The success of the Guild has also led to its being imitated, and further efforts of a similar nature are to be expected. The Guild, however, is strictly noncommercial and will always remain so under the provisions of its charter and the guidance of its distinguished advisory council. All it asks is that the affiliated clubs act with equal caution in respect to any attempt that may be made to commercialize them, and that they support the Guild by entering wholeheartedly into the great national program that is now under way.

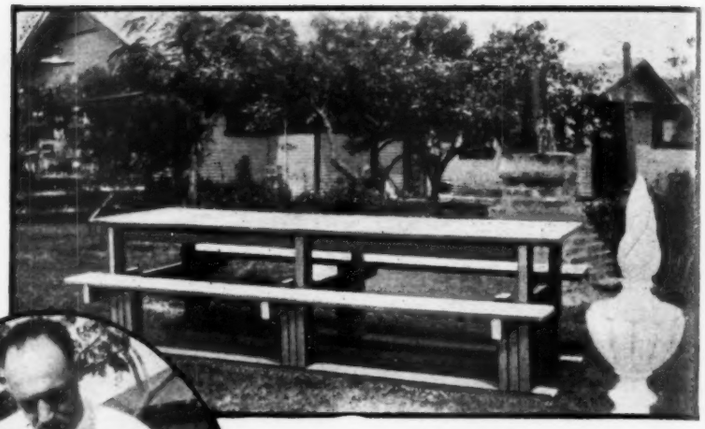


A meeting of the Jacksonville (Fla.) Homeworkshop Club. Members often bring their sons, and the boys are so interested that it may soon be necessary to start a junior auxiliary

The junior auxiliary sponsored by the Topeka Homeworkshop Club of Topeka, Kans., is now well organized. The boys will be given instructions in model airplane building, copper, brass, and iron work, photography, microscopy, woodworking, wood finishing, and any other hobby in which a sufficient number are interested. The Homeworkshop Club and the Y. M. C. A. will jointly supervise the work. Leo L. Gessell, boys' work secretary of the Y. M. C. A., is the chairman of the boys' work committee *(Continued on page 102)*

Portable Picnic Table

QUICKLY SET UP IN BACK YARD



NOW that we have an outside fireplace, I wish we had a large picnic table," my wife remarked recently.

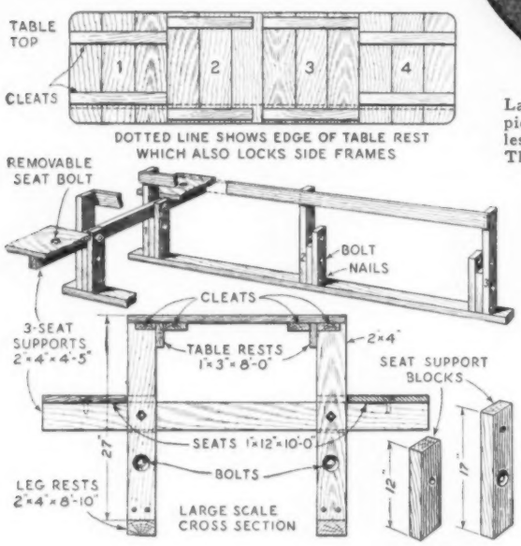
"That would be nice," I replied, "but a picnic table would be in the way all the time. It would be heavy to move in order to mow the grass, and the grass would turn yellow underneath it."

"Well, I'm going to have a table even if I have to get a 'skyhook' to keep it off the grass," she retorted jokingly.

This gave me an idea. Why not make a portable table? The result was the table shown, which has attracted much attention from our friends and neighbors.

When dismantled, the framework of the table is hung on pegs protruding from one side of the garage. The table top, consisting of four sections, is placed in the garage so it will not warp. The frame is held together by six bolts, which can be taken out or put in place very easily because no nuts are used.

Large and substantial as this back-yard picnic table is, it can be dismantled in less than three minutes and stored away. The drawings make the construction clear



Note particularly how the cleats are placed on the underside of the table-top sections so they will help brace the table. Screws should be used instead of nails. The cleats on sections 1 and 4 are placed so they will be on the outside, and the cleats on 2 and 3 on the inside, of the 1 by 3 in. top rest when the sections are in place on the frames. The cleats on section 2 are cut 2 in. shorter than the rest so as to allow for the center table legs.

The frames are both made like the complete one shown in the drawings. The 1 by 3 in. table rest, of course, is placed on the inside of both frames so that they face each other on the inside of the framework when the table is put together. The short 2 by 4 in. pieces, besides being nailed, are bolted to the legs with carriage bolts, one through each leg.

For the seat supports cut three pieces 2 by 4 in. by *(Continued on page 92)*

List of Materials

8 pc. 2 by 4 in. by 10 ft. (Cut 2 pc. 8 ft. 10. in. long for underside of legs; 6 pc. 2 ft. 3 in., 6 pc. 1 ft. 5 in., and 6 pc. 1 ft. long for legs. This can be done by cutting 2 table legs and the short pieces from each 2 by 4.)
1 pc. 2 by 4 in. by 14 ft. (Cut 3 pc. 4 ft. 5 in. long for seat supports.)
2 pc. 1 by 3 in. by 8 ft., surfaced four sides, for top rests.
2 pc. 1 by 3 in. by 10 ft. S4S. (Cut 6 pc. 2 ft. 2½ in. long and 2 pc. 2 ft. ½ in. long for table-top cleats.)
3 pc. 1 by 10 in. by 10 ft. S4S. (Cut 12 pc. 2 ft. 6 in. long for table-top sections.)
2 pc. 1 by 12 in. by 10 ft. S1S for seat boards.
6 carriage bolts 6 by ⅜ in. and nuts, and 12—⅜-in. washers for bolting leg pieces together.
6 machine bolts 5 by ⅜ in. (without nuts) to hold seat supports in place.
Nails, spikes, and screws.

OLD CABINET BECOMES END TABLE

THIS attractive, modern-looking bookcase end table was made from an old phonograph cabinet by Paul Meyer, a Chicago chef. First he cut off the top of the cabinet just below the sound chamber. Then he cut out the right side, making the cut close to each corner and over the floor of the cabinet. This side was used for the new top. One of the doors was then put on the side in place of the part that had been cut out. The old shelves that had held records were used to make divisions for the present shelves. The winged corners were rounded to form a pleasing curve under the top.

An angle iron was used on each of three corners, and one was placed at the end of the door on the side to fasten the top to the cabinet. The mechanical part of the phonograph was preserved unharmed.

The height of the cabinet from the floor is 26 in. The top is 22¾ by 19½ in., and extends over the sides ¾ in. all around. The two front shelves are 8½ in. deep.

One white undercoat and two coats of light red enamel were applied to cover the saw cut at the edge of the top and also on the entire interior. The cost of the new materials was 70 cents. This suggests other uses for cabinets.—JOHN F. RYAN.

Trays *with* Animal Handles

CAN BE MADE TO SELL AT A PROFIT

Decorative handles, which look to be hand-carved from wood, are the feature of these trays. The pictures are cut from wall paper and glued on strong composition board

By
Edward B. Fox

UNUSUALLY attractive trays that will serve as gifts or may often be sold at a good profit, because they look to be difficult and expensive to make, can be constructed by a very simple method. Their main feature is the ornamental handles—small animals cut out on a jig saw and "carved" on a sanding disk. These handles are so unique and seem to require so much more time and skill than they really do, that they invariably attract attention.

A convenient size for the trays is 13 by 20 in. Pressed wood composition boards 3/16 in. thick are recommended, as this material has no grain to cause warping. One side of the board is rough, with cloth pressed into its surface. Two coats of wall-paper size should be applied to this surface before coating it with white water-resisting casein glue. Wall paper is then used to cover this rough side of the board. Many beautiful designs are available, such as the fox-hunting scene illustrated.

The back of the paper is given a coat of size to prevent the glue coming through and causing stains. The glue itself is allowed to stand for half an hour after the powder has been mixed with cold water. A few minutes before you are ready to apply the glue with a stiff brush, give the wall paper, which should be cut so that it will overlap the board a little on all sides, a second coat of size. Spread the glue on the rough side of the board, and apply the paper while it is still wet. Smooth out all wrinkles. A rubber roller will be found useful at this point. Place a piece of smooth board over the paper, and pile heavy books or bricks on top of it. Allow several hours for drying. The wet wall paper shrinks, and a much smoother surface is obtained than if the paper had been applied dry.

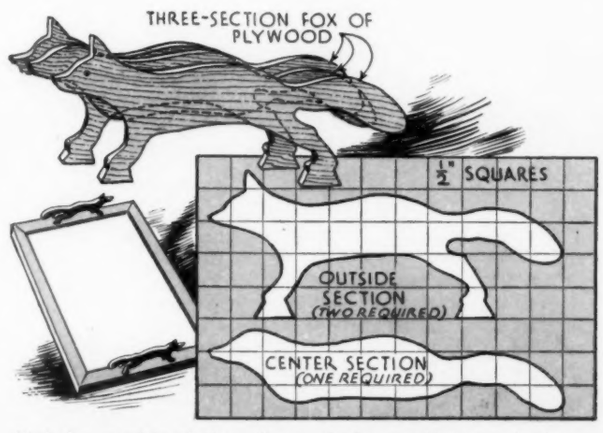
The next step is to apply two coats of size to the face of the paper, allowing an hour or more for each coat to dry. Then a coat of spar varnish is applied to one side of the unframed tray; and after it has dried, the opposite side is treated in the same way. If the paper has curved the board, bend it back into shape before applying the edges.

A small circular saw speeds up the operation of cutting the boards, and if it is equipped with a mitering guide, it can be used for cutting ½ by ¾ in. strips of wood known as "check stop" to form the raised edges for framing the tray. A dado cutter for making a 3/16-in. groove is set for a cut ¼ in. deep and is used on one of the narrow faces of the check stop before it is cut to the required lengths. If a dado is not available, your lumber company can probably supply the material properly grooved.

The border of the tray shown is painted a tulip red to match the hunting coats. The edges of the check stop along the groove should be painted and allowed to dry before fitting the mitered pieces in place around the pressed wood board; this does away with the chance of getting paint on the surface of the paper. The pressed wood should be very slightly beveled on the back edges. Care must be taken to see that the wall paper fits smoothly in the groove. All mitered corners are glued with waterproof casein glue and held in place with small wire nails. After the glue has dried, the nails are countersunk, and the holes filled with crack filler.

The handles are made as described in a previous article on jig-saw sculpture (P. S. M., July '34, p. 73), except that the feet are cut to fit dovetail recesses in the endpieces of the tray. These openings may be cut with a dovetail router on a drill press, or can be chipped out with a small carving chisel.

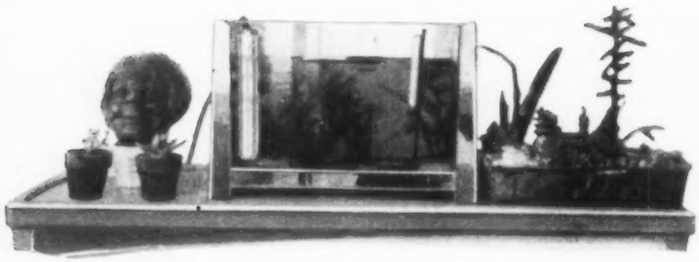
The foxes used for the tray illustrated are made from *(Continued on page 93)*



Each fox consists of three jig-sawed pieces, which are glued together and sanded to shape. The dovetails are set into the frame

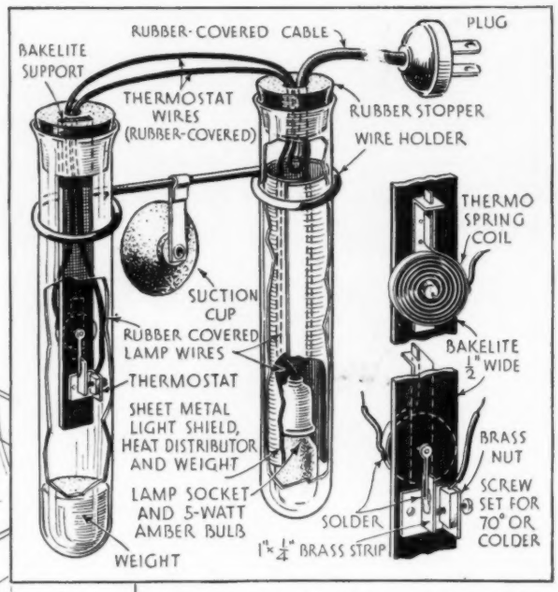
Aquarium Thermostat *and* Heater

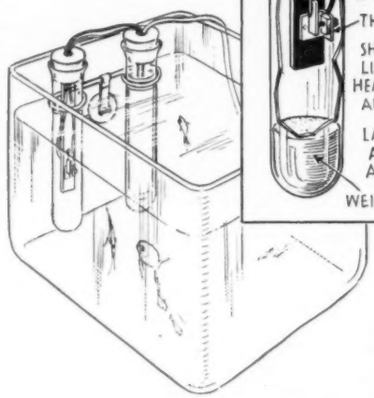
ASSEMBLED FOR A FEW CENTS



Although homemade, this thermostat and heater has many features found in high-priced instruments. It holds the temperature within a single degree

By KURT BORM





The thermostat is made from a cheap refrigerator thermometer, and the heater is a lamp

A DEPENDABLE, accurate aquarium heater and thermostat is an expensive item, which only a few tropical fish fanciers can afford, but it is possible, with a little patience, to build an excellent thermostatic heater at a cost of a few cents. The cost of operation is not more than 25 cents a month.

The heater consists of a small dark-colored 5-watt electric light bulb with socket to match (Christmas light type) inclosed in a large test tube, which is sealed by a rubber stopper. A piece of thin sheet metal, either copper, zinc, or tin, is rolled around inside of the tube and extends to within about ½ in. of the bottom. This metal serves to distribute the heat generated by the bulb, to close in most of its light, and to sink the heater and make it stand upright.

The thermostat is made from a spring taken from a clock-type thermometer which, after being mounted on a strip of bakelite, is also inclosed in a test tube covered by a rubber stopper. The thermometer can be bought at the local ten-cent store and should be of the refrigerator type reading from 0 to 100 deg. F. A length of rubber-covered wire is required to connect the heater with the nearest wall outlet.

The thermostat is constructed first. Dismantle the thermometer, take out the spring and indicator hand, and discard the rest. To the indicator hand, solder a thin piece of brass 1 in. long by ¼ in. wide. Now mount the spring on a strip of ½ in. wide bakelite by drilling a hole and sliding the spring shaft through it. After doing this, press the indicator on the shaft so that it points straight downward at 70 deg. F., and solder it in place. Bend a small brass angle from a 1 by ½ in. piece and solder a small nut with screw to one of its arms. The other arm is screwed to the bakelite 1 in. below the spring shaft. Adjust the set screw so that the hand will touch it at 70 deg. For correct operation, the set screw must be located on the right-hand side. The temperature can be raised by turning the screw to the left and vice versa. By means of a slot made in the rubber stopper, the thermostat can be fastened in the test tube.

The actual heater is very simple to make. Screw the bulb into the socket and solder one of the wires of the cable to one of the two socket connections. The other wire coming from the socket is soldered to the thermostat spring. The not yet connected cable wire is then soldered to the set screw in the thermostat. All the wires, of course, have to pass through the rubber stoppers after suitable holes have been made.

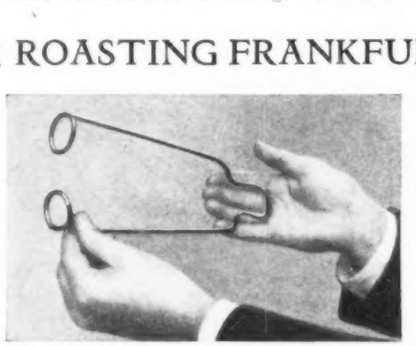
A holder for fastening the heater to your aquarium may be made from a piece of bus-bar wire and a rubber suction cup.

SPRING HOLDER FOR ROASTING FRANKFURTERS

HOLDERS for roasting frankfurters or "weiners" over an open fire can be made as shown from a 3-ft. length of heavy wire or, without any work at all, from the springlike spreaders used in rolls of roofing paper to keep the can of tar and nails from shifting. Nail or staple these wires to sticks about 3 ft. long.

If you are going on a camping trip and are crowded for space in your car, do not bother with the sticks. Take the wires and a few staples along and get suitable sticks at the camping grounds. When you are ready to return, either pull out the staples or burn the sticks from the wires in the camp fire.

To use these holders, simply press the wire spring together and insert a frankfurter in the end. The frankfurter is not pierced as when a pointed stick or a long wire fork is used, and it is not nearly so likely to fall into the fire—a mishap that is as frequent as it is annoying.—J. P. K.

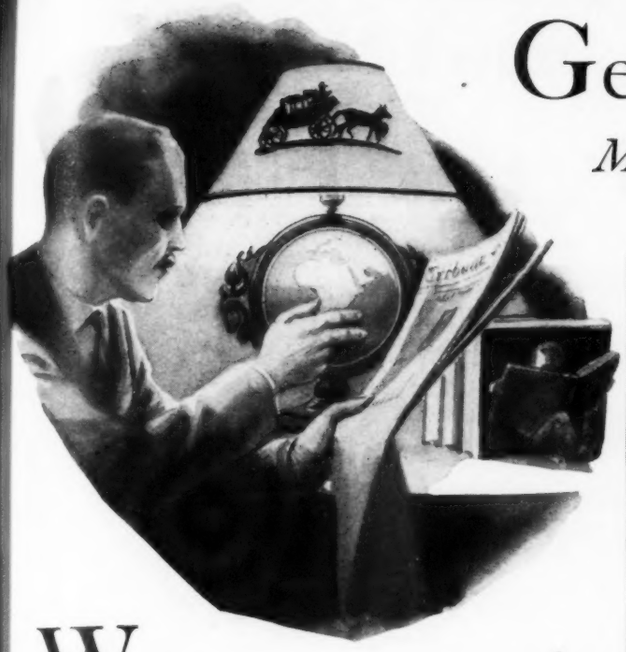


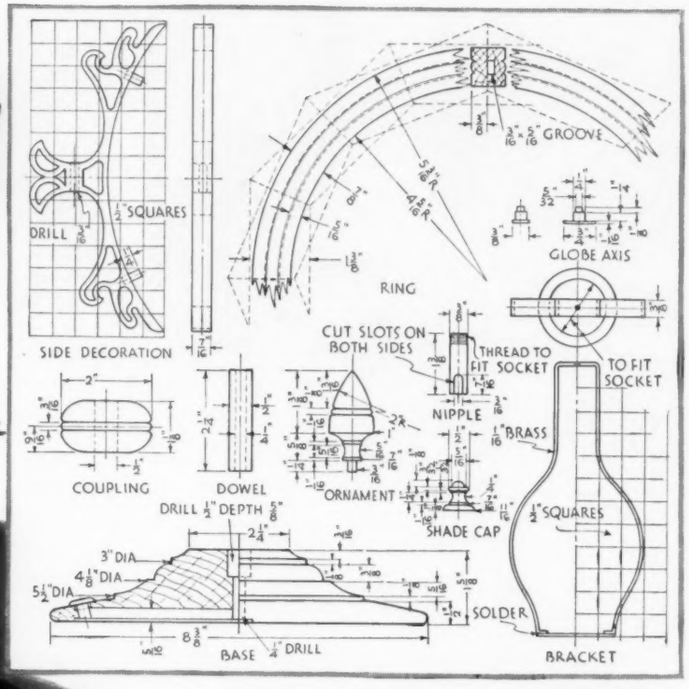
When pressed together, the two loops at the ends of the wire grip the frankfurter

Geographical Globe

Mounted Under Reading Lamp

BY EDWIN PUTZER

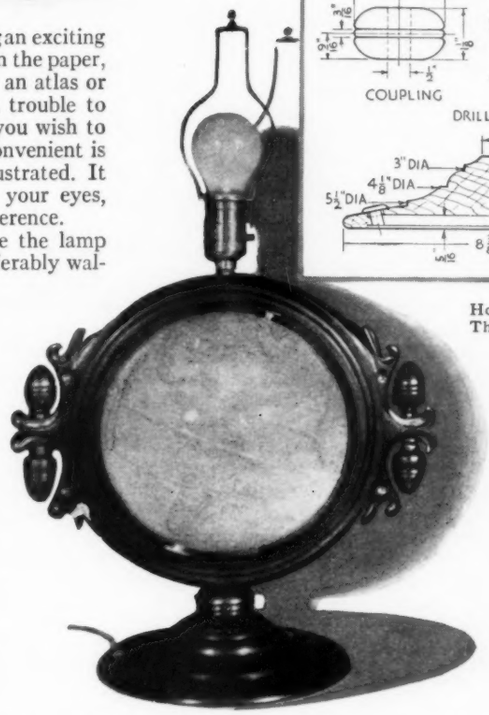




How the parts are made and, at left, the assembled lamp. The globe axis is at a 25-deg. angle from the vertical

WHEN you are reading an exciting bit of foreign news in the paper, you often feel like referring to an atlas or geography, but it is too much trouble to get up and hunt for the map you wish to consult. What is much more convenient is a table lamp like the one illustrated. It keeps the whole globe before your eyes, well illuminated for instant reference.

All that is required to make the lamp are a few pieces of wood, preferably walnut, an 8-in. terrestrial globe, which may be purchased at any office supply store, and the necessary electrical fixtures.



In making the ring, which is built from segments, sixteen pieces of wood 7/16 by 1⅜ by 4¾ in. are needed. Screw a piece of wood ¾ in. thick by 11 in. diameter to the lathe faceplate, true this, and glue on a sheet of paper or cardboard. Glue the first layer of segments to this paper. After the glue has hardened, turn the face to ⅜ in. thickness, 10⅜ in. outside diameter, and 8⅝ in. inside diameter. Turn the groove for the lamp cord next. Glue on the next layer of segments as shown, and turn to the dimensions of the first layer. Then turn the bead. Separate the ring from the wooden disk by inserting a chisel into the paper to split it. To turn the bead on the opposite side, chuck the ring by turning a recess in the wooden disk to fit the outside diameter of the ring tightly.

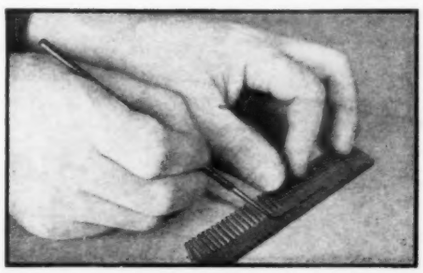
Turn the base and side ornaments. The base is gouged out at the bottom for the lamp cord as shown. A piece of wood 1/16 by ⅜ by 4 in. is then fitted into the base to cover up the cord. The side decorations were carved on the original lamp, but they may be simplified by cutting them out on the jig saw as shown on the drawing, or they may be omitted.

Pull silk lamp cord through the base, and remove the silk covering from the end for a distance of 18 in. Pass one wire up the left side of the groove and the other up the right, both meeting at the top. Slip the nipple into the drilled hole at the top of the ring after cutting slots to fit over the wires.

Now the lamp may be permanently assembled, sandpapered smooth, and stained to desired shade. If open-grained wood has been used, apply paste wood filler, rubbing it off after it has turned dull. Let it stand for twenty-four hours before applying the first coat of varnish. Allow this to dry for three days, and then sand smooth. Apply the second coat, and allow it to dry from four to five days. This should then be rubbed with fine pumice stone and rubbing oil, followed with rottenstone and finally with a good grade of furniture polish.

To support the globe, make two axes from 1/16 by ⅜ by ¾ in. brass, to which is soldered a ¼-in. brass rod filed to the diameter of the hole in the globe.

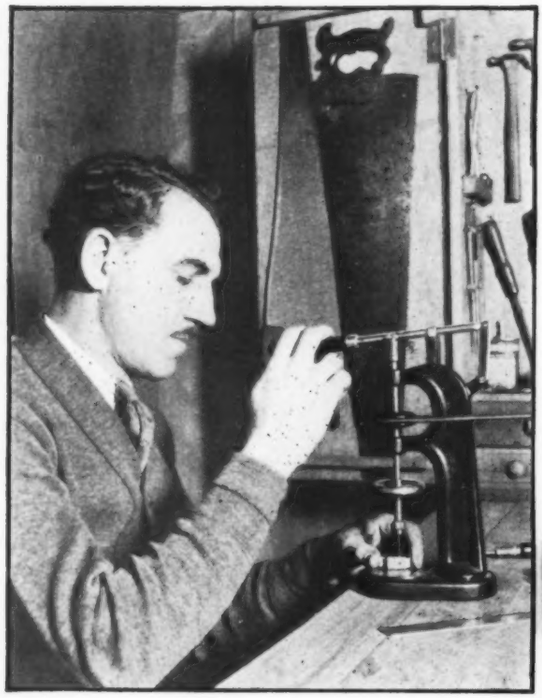
The lamp shade may be purchased or made from parchment paper cut to the required shape and reënforced at top and bottom with wire and binding. Silhouettes may be painted on. The coach on the shade illustrated was taken from a previous issue (P. S. M., Nov. '30, p. 94). A bracket to support the shade may be made as shown in the drawing. For a method of rolling the wire for the shade, see the article "An Easy Way to Bend and Assemble Wire Lamp Shade Frames," published in P. S. M., Aug. '32, p. 94.



WRITING ON CELLULOID

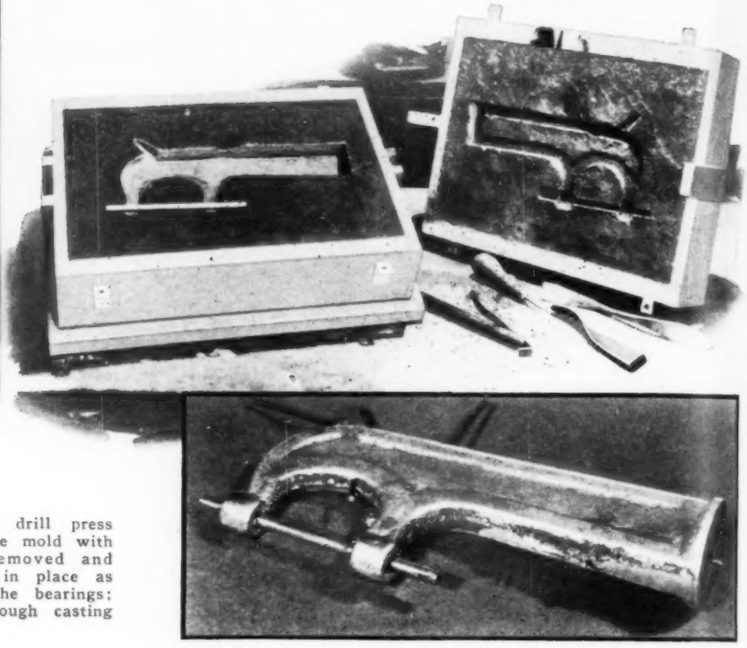
SOLUBLE aniline dye dissolved in amyl acetate is an excellent permanent ink that can be used with an ordinary steel pen for writing on celluloid articles such as combs and toothbrush handles. It will also mark for identification photographic films, both "still" and movie. The ink can be made to dry faster by adding acetone, but this also causes it to dry on the pen quickly, which is a drawback.—G. S. G.

BLUEPRINTS for Popular Science Monthly projects are listed on page 98.



Model Maker's DRILL PRESS

Built with Type-Metal Castings



The little drill press in use; the mold with pattern removed and steel rod in place as core for the bearings; and the rough casting

BY J. W. CLEMENT

HOMEMADE castings of type metal give this drill press its neat and trim appearance. It can be made with a few simple tools, is smooth running, and will be found convenient for drilling those innumerable small holes needed in model work. The chuck and table are easily aligned, making it possible to produce accurate results.

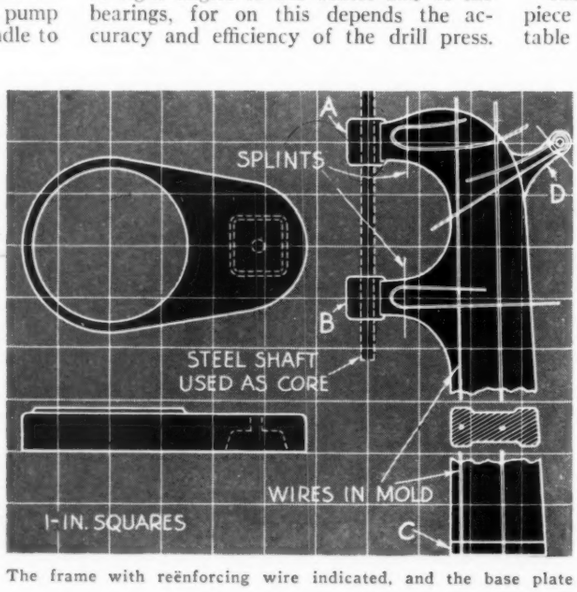
Any type metal will do, but the kind known as stereotype metal, used in casting type in the form of an entire page or part of a page, will give the best results. It is hard and tough, has a low melting point, and where the stresses are not great it serves the purpose as well as any other metal.

The total cost of the drill press in this particular case was only one dollar, which covered the purchase of a jeweler's pump drill, consisting of a chuck and spindle to which was attached a small brass balance wheel. The dimensions given, which are based on the size of this chuck and spindle, may have to be altered to fit the particular chuck and spindle used.

The spindle was originally 11 in. long, but was cut down to make the total length above the balance wheel 6 in. This balance wheel was left in place as it does not detract from the appearance of the drill press and does add materially to its smooth-running qualities.

The pattern used for the frame is made of ⅞-in. white pine; and the two bearings, shown at *A* and *B*, are sections of a ¾-in. dowel, glued and nailed in place. The pattern is planed down until the upper part and the two arms which hold the bearings are approximately ½ in. thick. Note that the sides of the pattern are recessed. This reduces the weight of the finished casting, but does not detract from its strength.

A disk of ¼-in. white pine 1⅞ in. in diameter is fastened at the foot of the pattern as shown at *C*. This gives a larger bearing surface where the drill frame rests on the base. The angle formed between the two pieces should be filled out with a plastic wood composition or putty so that the pattern can be more easily removed from the mold. The disk should be set at right angles to the center line of the bearings, for on this depends the accuracy and efficiency of the drill press.



The frame with reënforcing wire indicated, and the base plate

A short section of steel shafting of exactly the same diameter as the spindle is used as a core for the two bearings and left in the mold while the casting is being poured. The use of this rod as a core eliminates the necessity of drilling the holes and leaves the bearings smooth and in perfect alignment. The small arm *D*, used for holding the link between the frame and feed lever, is made with the pattern proper, although it could be a separate piece.

The pattern for the base is cut from one piece of ¾-in. white pine. The raised table is a thin disk of wood glued and nailed in place. A recess is cut in the bottom of the pattern to accommodate the head of the machine screw that holds the frame and base together.

Both patterns should be well sanded and given two coats of shellac to protect them from the moisture of the damp molding sand.

The flask for making the mold should be at least 6 in. wide and 10 in. long. This size flask will take the larger pattern easily. As complete instructions for making a green sand mold have already been published in this magazine, the details of this phase of the work are omitted. (See P. S. M., Oct. '32, p. 93; Nov. '32, p. 96; Dec. '32, p. 102.)

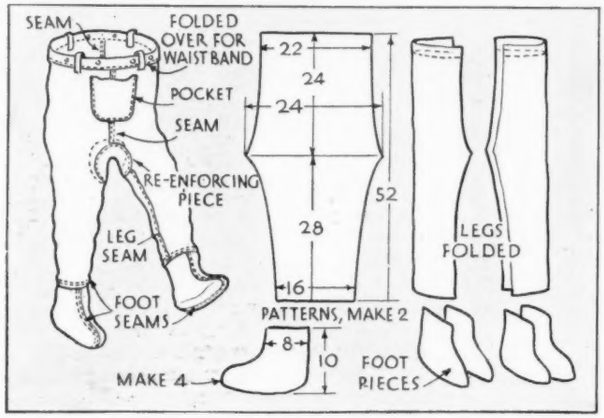
The method of reënforcing the casting is indicated in the drawing of *(Continued on page 93)*

Fishing Waders

MADE FROM MUSLIN AT LOW COST

Durable home-made waders waterproofed with coats of rubber cement

By *Ludwig Stanley Landmichl*



How to lay out waders for a man of average height and weight

FISHING waders can be made at a fraction of the price asked for them in sporting goods stores. Obtain about 3 yd. of heavy unbleached muslin of fine weave. The thread count should be 80 by 80 per square inch. Next get a piece of light wrapping paper about 26 by 60 in., fold it lengthwise through the center, and sketch one side of the pattern. When cut along the line with shears, both sides of the pattern will be uniform. The pattern illustrated is for a person of average height, from 160 to 180 lb. If the waders are to be for a short, heavy person, make the pattern shorter and broader. If for a tall, thin person, change it to suit.

Fold the material lengthwise along the center (or wide enough to fit the pattern). Cut two pieces like the pattern, and from the trimmings, cut four pieces for the feet.

Sew the foot pieces together in pairs. Lap the edge of one cloth over the edge of the other about ½ in., and sew with a double or triple stitch all around, except at the top. Now lap and sew one of the leg pieces in the same way. Start at the bottom and sew up only 8 or 10 in., no more, otherwise there will be difficulty sewing on the feet.

Slip the foot piece over the bottom of the leg (or inside the leg) about ¾ in. As there is only one leg seam, which will be at the inside of the leg when the waders are worn, be sure to sew the foot in correctly. Have the leg seam come midway between the front and back seams of the foot.

Triple-stitch the foot to the leg; then finish sewing the leg up to the point of the crotch. Sew the other foot and leg similarly. Be sure the feet will both point the same way when the legs are sewn together from the crotch up, which will form the waist.

When the two parts are sewn, fold the top edge down about 2 in. and double-stitch to form a waistband for buttons. If you want belt loops, put them on now.

Cut a piece of the same material 9 by 12 in. and double-stitch it to the front of the waders about 1 in. from the top edge. Sew this at the bottom and both sides, also at the top about 2 in. in from the sides. This forms a roomy pocket for carrying lures, baits, "skeeter dope," and the like.

Your waders are now ready for waterproofing. You may put on several coats of the regular commercial waterproofing sold for use on tents. This undoubtedly will serve the purpose satisfactorily, but I much prefer using rubber cement. With a stiff paintbrush, apply several coats of rubber cement such as is used for tire repairing. Work the rubber cement in thoroughly. Let each coat dry before applying the next coat, which, depending upon the temperature, may take one to three days. Spread the cement over all seams generously.

Be sure to apply plenty of waterproofing on the feet, as that will be the only place where you may have trouble with leaks.

It is also a good idea to double-stitch a small round reënforcing patch over the crotch where all seams join. This should be put on before the waders are waterproofed.

A suit of heavy underwear is about all that is necessary inside the waders. Wear a pair of thin socks, and over the outside of the wader feet put on a pair of thick coarse wool socks. To keep the socks from rolling down, tie them with a cord or use a rubber band cut from an inner tube. Over these wear hobnailed leather shoes, or a pair of rubber-bottom canvas shoes such as are used for athletics.

Sew on suspender buttons after waterproofing, and shorten a pair of old suspenders to fit. A belt may be worn in the loops as a measure of safety if found necessary—that is, in case one falls in the water or gets in too deep.

I have been in the water to the top of my waders, and have kept dry and warm in icy waters when trout fishing. I wear heavy wool socks and corrugated rubber-bottom canvas shoes, although the latter are not shown in the photograph.

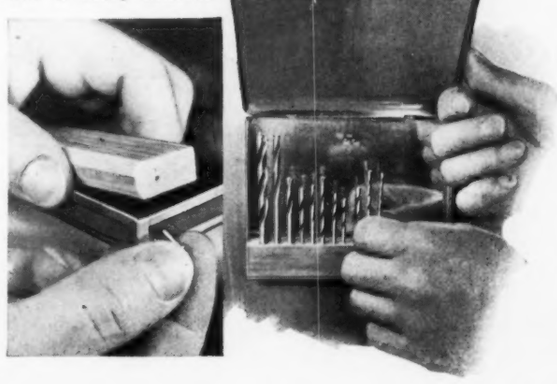
Besides saving considerable outlay in cash, it's a lot of fun making your own fishing waders.

CIGARETTE TIN HOLDS SMALL DRILLS

ONE of the flat "fifties" cigarette tins can be made into a handy holder for small and medium-sized twist drills. This can be attached to the wall near the drill press or in any convenient position. It also helps preserve the bits from rust, especially if a small piece of cotton with the so-called "penetrating" type oil on it is fastened in one corner.

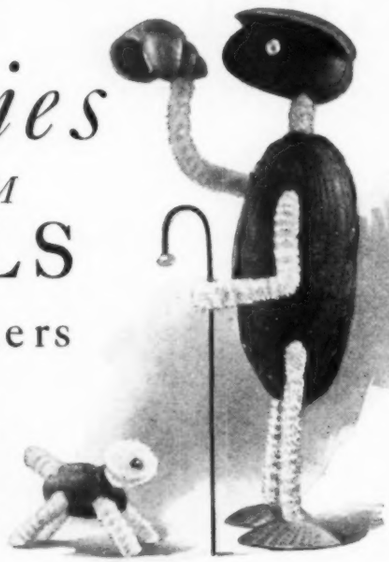
Cut a small strip of wood to fit in the box as shown; then, after making holes for the drill bits, fasten the strip in place with a single small brad at each end. The bottom part of the strip should be rounded off so that the bits can be swung outwards easily. When this is done, the desired drill can be removed without difficulty.—K. L. ROBBINS.

The wooden block swings out so that the desired drill is easily removed



TURN LOOSE YOUR IMAGINATION AND MAKE SOME

Novelties FROM SHELLS *and* Pipe Cleaners

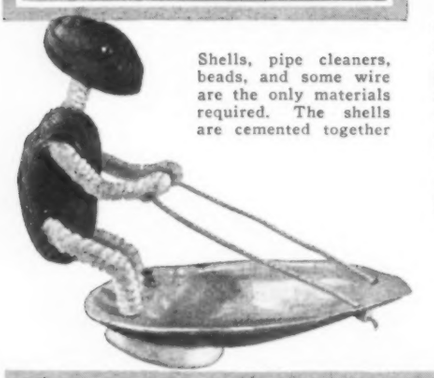


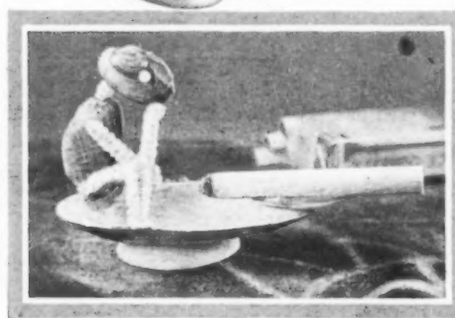
Shells, pipe cleaners, beads, and some wire are the only materials required. The shells are cemented together

IF YOUR vacation takes you near a lake or ocean beach this summer, be sure to gather a box of shells in assorted sizes and varieties for making odd table and aquarium ornaments. The only other materials needed are some pipe cleaners, plaster of Paris, water glass, cellulose-type cement, and a 10-cent string of assorted small beads.

The transparent cement will hold the shells together firmly, and where there is a fire hazard, as with ash trays, water glass will do the job nicely. To weight half-shells with plaster, first give the insides a coat of water glass so that the plaster will adhere permaently.

The beads make excellent glass eyes. Coat the figures, if you wish, with clear lacquer or varnish.—E. A. BOWER.

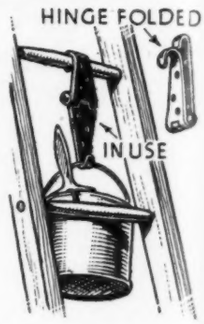




"The Surf Rider" and "The Thinker"—two ash trays. *In circle:* A seaplane made of shells

At right: Shells that are to form the feet of figures or animals or the bottom pieces of other novelties are filled with plaster of Paris. When drilling, hold shells in your hand and press lightly

PAINT-CAN HOOK MADE FROM STRAP HINGE



THOSE who do their own house painting and are continually mislaying their paint-can hooks will appreciate the folding hook illustrated. It is made from a light strap-iron hinge, bent as shown. One of the hooks is bent so that it will fit the rung of the ladder, and the other is made smaller for the paint-can handle. When moving from one place to another, the painter can fold up the hook and slip it in his pocket.—EMIL J. NOVAK.

Old Bill *Says . .*

***DON'T** hesitate to use your magnifying glass. The microscope will soon be a regular instrument in all up-to-date machine shop inspection departments.*

. . .

To thread fiber, the tool should have a negative top rake.

. . .

A slightly worn bronze bushing can usually be saved by driving it out and giving the diameter a heavy knurling. When pressed into place again, it will close sufficiently to allow the bore to be reamed.

. . .

For burring the edges of small bores, a conical grinding wheel saves time.

. . .

Never use a cemented carbide tool in a machine that vibrates or has worn bearings or ways.

. . .

An economical way to give a first test to a gang of milling cutters is to mill a wood template.

. . .

For tapping blind holes, the taper of the finishing tap should not be more than one thread.

. . .

When used for filing aluminum either in the bench vise or the lathe, the file will stay clean longer if it is occasionally dipped in lard oil.

. . .

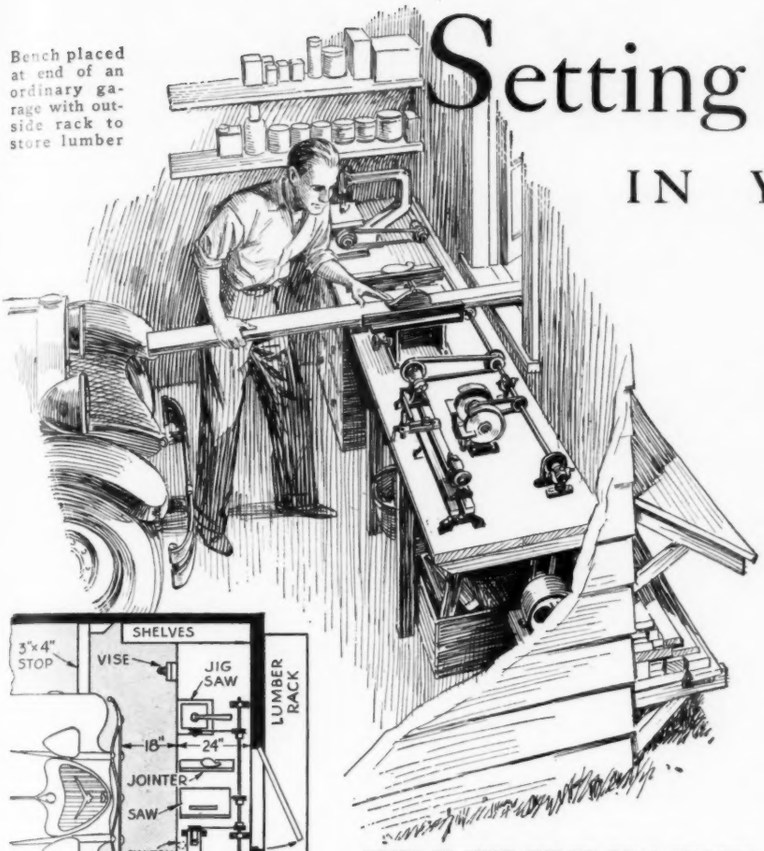
Always lubricate fillister head machine screws and cap screws before screwing them in place. Graphite and oil, or white or red lead, are suitable for this purpose.

. . .

Pieces of drill rod, cut the proper length and relieved by turning them on the lathe back of the cutting edges, will make good slotter tool bits. Any size radius can be had without grinding.

Setting Up a Shop

IN YOUR GARAGE



Bench placed at end of an ordinary garage with outside rack to store lumber

THIS IS THE FIRST OF A SERIES OF ARTICLES ON HOW TO LAY OUT MODERN MOTORIZED WORKSHOPS OF VARIOUS TYPES AND SIZES

ABOUT the simplest and least expensive home workshop for the beginner is a bench across the *end* of the garage, not the side. Most garages are somewhat longer than the over-all size of modern automobiles, and this extra space is admirably adapted for workshop purposes. There is usually at least one window for daytime light. A 3 by 4 in. timber installed across the floor serves as a stop to keep the car from encroaching on the little shop, and at the same time prevents shavings and debris from littering the space rightfully belonging to the car.

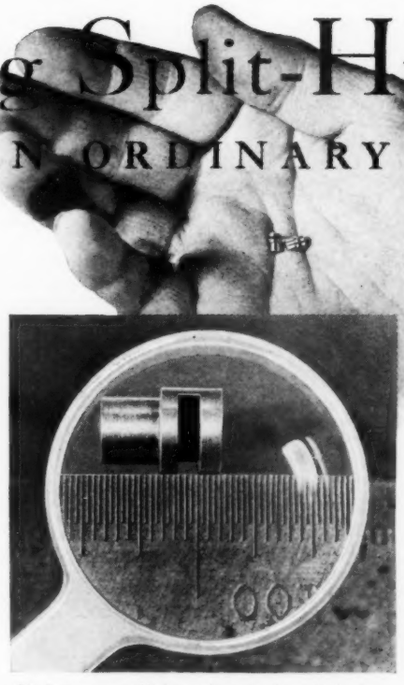
A workbench built of 2-in. planks, which are about 1⅝ in. actual thickness when surfaced, is much more desirable than one of ¾-in. stock. It should be well braced and have at least two 2 by 4 in. legs in addition to the end supports. Tool drawers and shelves should be included.

The first workshop often includes a lathe and a circular saw. On this assumption, arrange these machines as shown in the plan drawing, with the motor below the bench to conserve space. The diagram indicates convenient locations for other machines as they are acquired from time to time. They can be driven from the initial motor by adding to the countershaft. Note that the circular saw and jointer are installed opposite the window so that long boards can be passed through it.

An open lumber rack with a roof can be built on the outside of the garage, as shown, and short pieces may be kept out of the way in boxes under the bench.—HI SIBLEY.

Measuring Split-Hundredths

WITH AN ORDINARY SCALE



Under a magnifying glass it is relatively easy to make measurements within .01 inch

DO YOU realize what can be done in the way of accurate measuring with an ordinary, high-grade steel scale? The hundredth of an inch divisions were not put on the scale as an ornament or to impress you with the quality of the tool. They are for use, and with a little patience and practice you can split the hundredths and make linear measurements correctly within a few thousandths of an inch.

Hair-splitting precision like this is easy. All you need is the scale, a small magnifying glass, a reasonable supply of patience, and above all, confidence in the fact that it can be done and that you can do it.

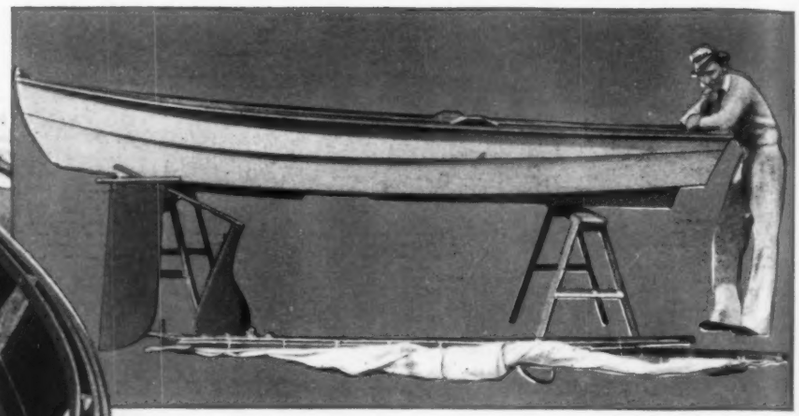
As an example, look at the two tiny slotted-head brass studs in the palm of the hand shown in the photograph above. The original pieces, of which these are copies, were located in such a position on the apparatus of which they are a part, that it was not possible to get at them even to measure the head diameter with an ordinary micrometer. All measurements were taken from the originals with the aid of nothing but a steel scale and a small magnifying glass.

Then a small brass rod was chucked in the lathe and two slots sawed in it sufficiently far apart to make the two pieces. A diamond pointed tool was then adjusted in the lathe tool holder at an angle so that the sides of the point cleared both the lengthwise and crosswise faces. Cuts were taken with great care, using the saw cuts as reference points, and the same scale and magnifying glass were used for the measurements.

On this job the critical dimension happened to be the distance from the upper edge of the saw cut to the shoulder on the stud. The second photograph shows one of the studs placed against the edge of the scale. This illustrates how coarse and easily read the hundredths of an inch divisions appear under a magnifying glass. It is clear, even from the photograph, that the dimension in question is a trifle over six and one half divisions and is, therefore, approximately .066 in., the required size. A check-up after the studs were finished showed one of them calibrated .0668 in., the other .0672 in.

The matter of getting proper light is extremely important. Have the light evenly diffused from both sides, and check each measurement from two positions if possible.—THOMAS W. ARNOLD.

You Can Get Endless Sport Out of Our New General



The last word in Homebuilt ROWBOATS

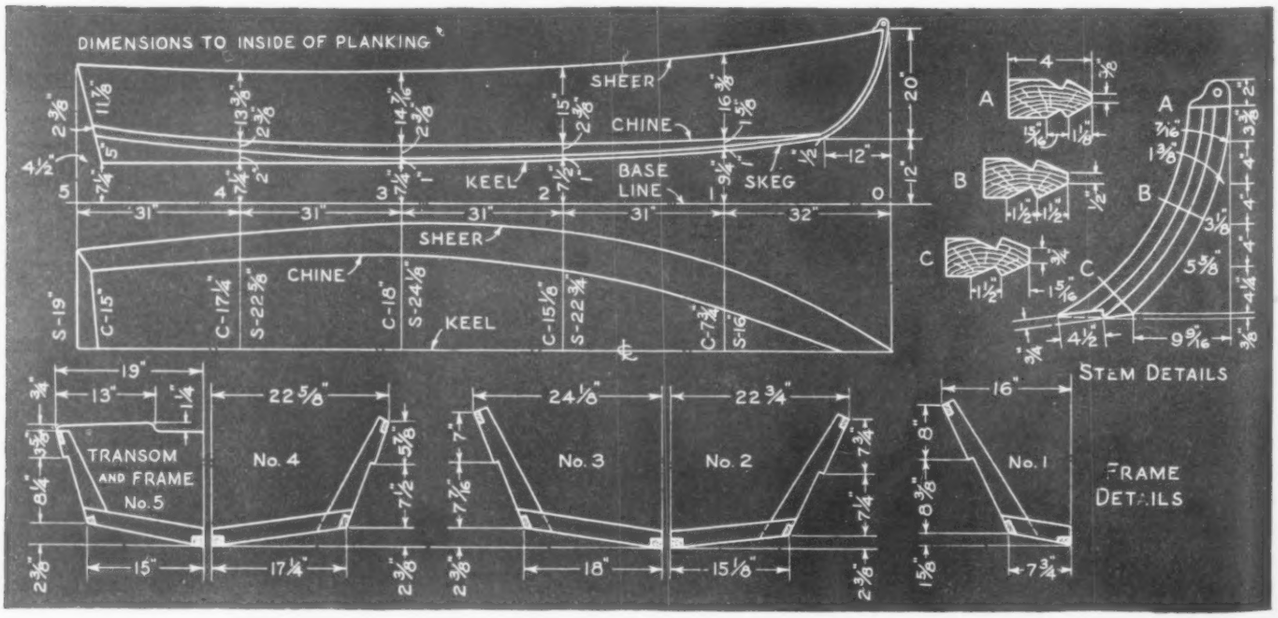
"Give us the last word in rowboats," is the request that readers have been making more and more frequently. We told William Jackson, our boat designer, to see what he could do. The result speaks for itself. He has designed the ideal general utility rowboat for any amateur to build. It is simple, inexpensive, light, stanch, and seaworthy. Not only does it row easily, but it can be sailed or powered with a small outboard motor.

HERE is a new rowboat *Mate* that is in a class by itself—the final development of a long line of forerunners. This graceful little V-bottom craft is 13 ft. long, carries from four to six passengers, rows easily, sails like a charm, and may be powered with a small outboard motor of from 2 to 12 H.P. for fishing, camping or high adventure. The construction is relatively simple and the cost of materials low—not more than $30 at most.

Mate has been tested under all conditions and is exceptionally seaworthy and dry in choppy seas. The lap-strake construction makes the hull rigid and insures that it will remain water-tight even when the boat is taken out of the water and put in again at infrequent intervals. The boat weighs from 175 to 190 lb., depending upon the materials, and consequently may be transported easily by trailer.

Before starting the construction, study the plans and list of materials carefully. Although this hull has already been laid down full size on paper, many times a better conception of the boat as a whole may be had by the builder if he does this work himself. Incidentally, patterns of the stem, breast hook, skeg, and transom knees may be taken from the full-size layout.

The 2 by 10 in. by 12 ft. form upon which the hull is built should be shaped and notched out for the frames as shown. Mount the form upon wooden legs similar to a sawhorse and high enough to be convenient.



Utility Rowboat

AN IMPROVED DESIGN FOR AMATEUR BUILDERS . . TAKES SAIL OR MOTOR

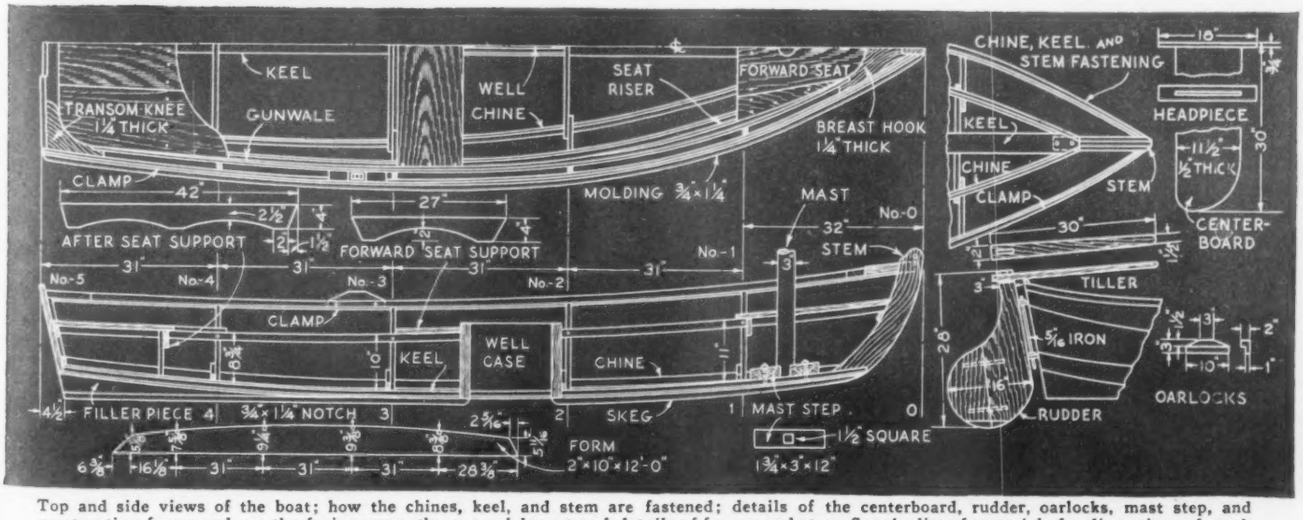
By *William Jackson*

While primarily a rowboat, this stanch little craft can be rigged for sailing. There is a mast step forward, a small centerboard, and a rudder

Frames and stem (in circle), how they are set up on a form, and (above) interior of the hull

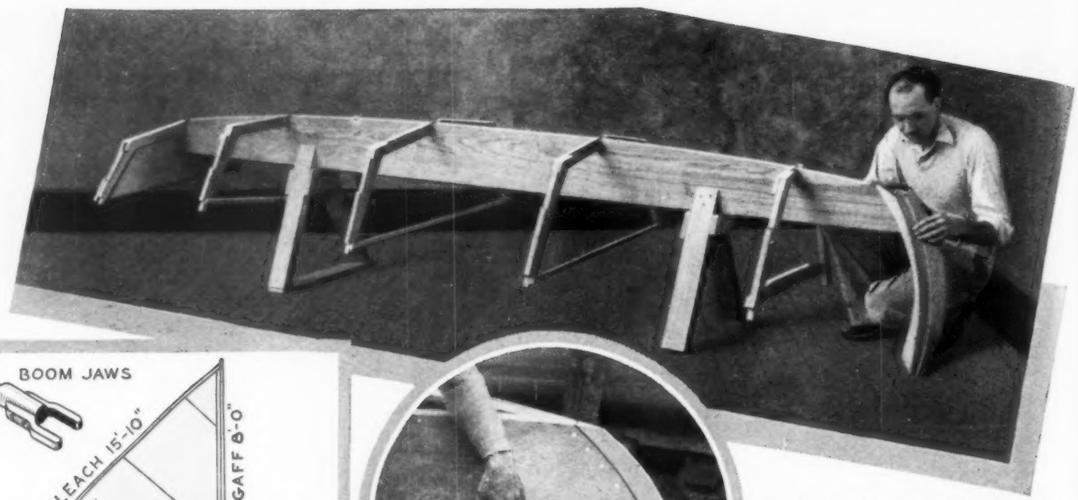
Make full-size paper patterns of the stem and frames. Lay them on the ¾-in. frame material and the 1¾ by 8 by 27 in. stock for the stem. Prick the outline through by driving brads and removing them or by using a dressmaker's toothed wheel. Connect the marks with pencil lines. To allow for beveling, leave the top edge of side members marked Nos. 1 and 2 fully ½ in. wider. This edge will then measure 2 in. Saw the frame parts and stem to shape and trim the edges evenly.

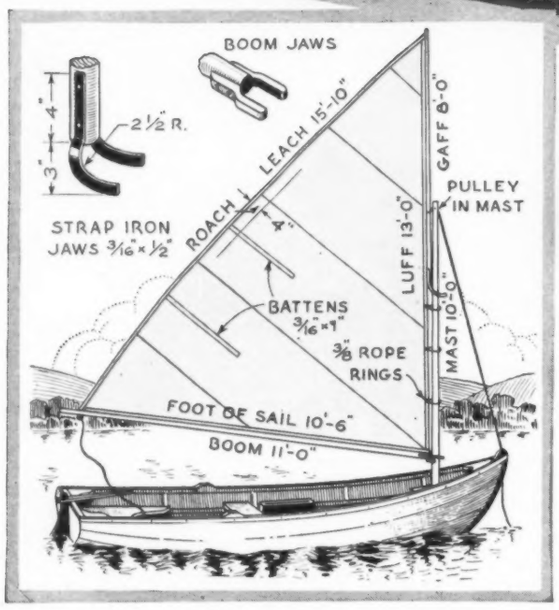
Lay the side and bottom frame members on the paper patterns so as to conform to the

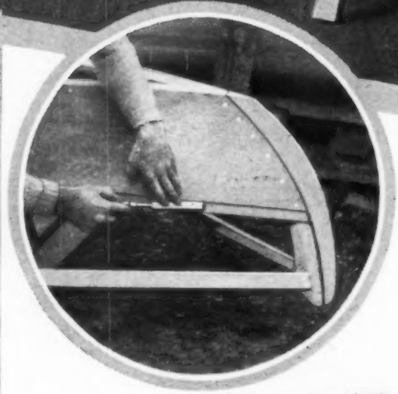


Top and side views of the boat; how the chines, keel, and stem are fastened; details of the centerboard, rudder, oarlocks, mast step, and construction form; and, on the facing page, the general layout and details of frames and stem. See the list of materials for dimensions of stock

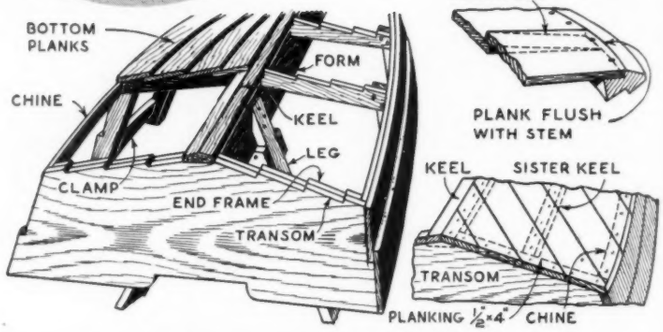
The frames are set up on a notched form made as shown in the drawing at the bottom of the preceding page. This form is placed on legs like a sawhorse at a convenient height for working in comfort







As the boat is of lap-strake design, the planks are overlapped except at the stem, where both planks are chiseled out to allow the upper to come flush with the stem, as shown at left and below



The sail plan and, at right, how the side planks are fitted at stem and two methods of laying the bottom planking—lapped or laid diagonally with butt joints

outline, and bolt together with two 2 by ¼ in. carriage bolts at each joint. Before fastening, coat the adjoining surfaces with casein glue. Nail ¾-in. wood strips across the frames to hold the shape.

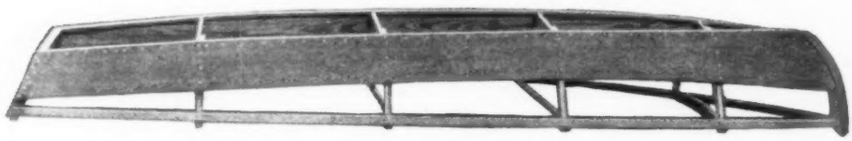
The stem is now carefully beveled and rabbeted as shown in the three details. Cut the rabbet ½ in. deep, using a piece of planking with the edge cut square as a depth gage.

Clamp the stem to the form and temporarily assemble the frames on the form. Bend a light batten around the frames, and mark the bevel on the outside frame edges. Remove frames and bevel edges. Cut the notches for the clamp, keel, planks, and chines in the frames, following the bevel on each frame.

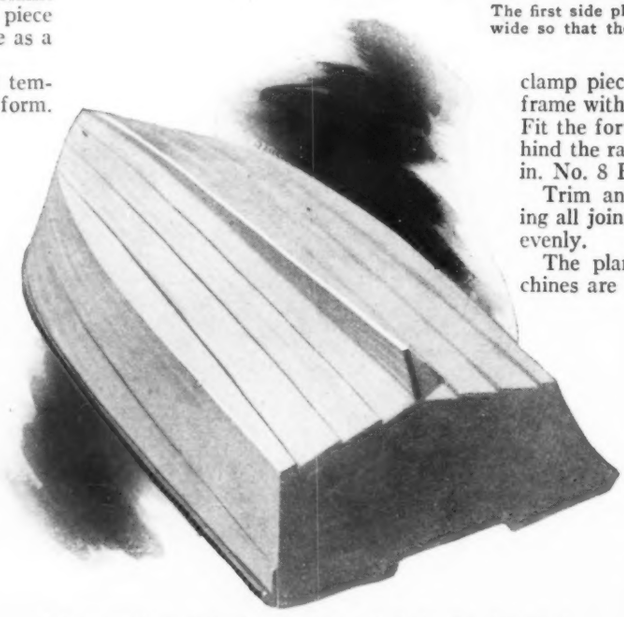
Replace the frames on the form and fasten the ¾ by 3 in. keel to each frame and to the stem with two 1¾-in. No. 8 F.H. (flathead) screws. Incidentally, galvanized screws are cheaper and will serve as satisfactorily as brass.

Square and line up the frames, and clamp the ¾ by 1½ in. chines in place. Fasten the chine to each frame with one 2-in. No. 10 F.H. screw. Fit the forward ends against the keel and fasten with one 1¾-in. No. 8 F.H. screw on each side. Fasten both chines simultaneously.

Square and line up the side members, clamp the ½ by 1½ in.



The first side planks are sawed from a board 12 in. wide so that they fit the frame notches accurately



A bottom view of the hull. Note particularly the skeg. It is a ¾ by 1 in. strip with a triangular filler piece at the stern

clamp piece in place, and fasten to each frame with one 1¼-in. No. 8 F.H. screw. Fit the forward ends to the stem, just behind the rabbet, and fasten with two 1¼-in. No. 8 F.H. screws.

Trim and fair the entire frame, planing all joints down so the planking will fit evenly.

The planks on each side next to the chines are attached first. Clamp a ½ by 12 in. by 14 ft. plank in place so it fits the frame notches snugly. Carefully measure and fit the forward end in the stem rabbet. Mark along the chine edge, remove, and saw to shape.

To make the side and bottom planks fit flush together at the forward ends, a rabbet joint is cut with knife and chisel as shown. The depth of the rabbet runs from nothing 24 in. back from the end to half the thickness of the

(Continued on page 100)

EASY WAYS TO MAKE

Castings, Deadeyes, Blocks

for Your SHIP MODELS

By Capt. E. Armitage McCann

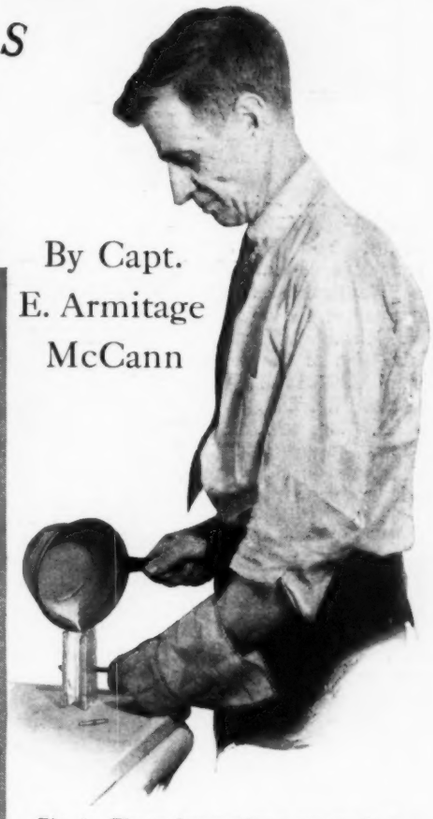
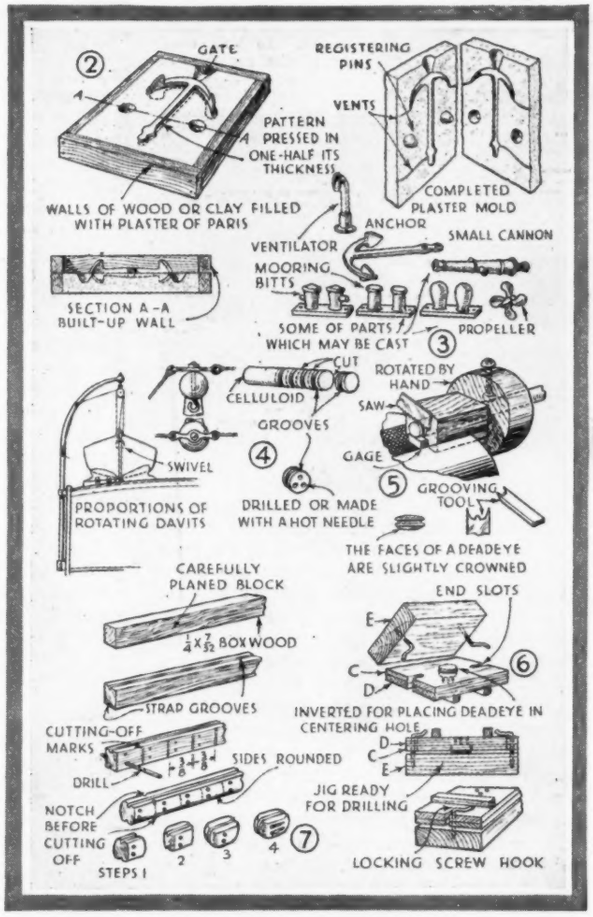


Fig. 1. The author casting a cannon in a plaster mold. If asbestos is added to the plaster, a mold will serve for many casts

ANCHORS, guns, propellers, and similar parts for ship models can be made of wood, but never look quite right. It is much better to take the little extra pains required to cast them in lead. Bronze is, of course, preferable to lead, but it is easier to use the softer metal.

Lead Castings. To make anchors, for example, first prepare a pattern from wood. Build a ½ in. high wall of wood or modeling clay on any scrap of wood and fill with a soft mixture of plaster of Paris and water. Grease or oil the pattern, lay it on the mixture, and press it in until just one half submerged, as shown in Fig. 2. Leave it until the plaster dries. Then remove the pattern and countersink several holes in the margin of the plaster. Replace the pattern, build the walls up another ½ in., grease the top surface of the mold, and fill with newly mixed plaster of Paris. Place a thin piece of wood on top and leave until dry. Carefully separate the two halves of the mold and remove the pattern. Cut a gate or spout from the crown end of the anchor depression to the edge of the mold in which to pour the metal. Make hair-line scratches to serve as air vents from the ends of the flukes and shank to the edges. Dry the mold very thoroughly. It must be bone dry. If a number of castings are to be made, use half plaster and half powdered asbestos for making the mold.



How to make a plaster mold for an anchor; other parts which can easily be cast; a rotating davit; preparing deadeyes and blocks

As a backing for the mold it is well to use two pieces of thin wood such as ¼ in. three-ply not much larger than the mold and leave the plaster permanently attached to them.

Lightly clamp the two parts together. Melt some lead in a ladle or an old saucepan and pour it into the mold (Fig. 1). The first few castings, until the mold gets thoroughly hot, will probably be failures. Scrap type metal may be used instead of lead and has the advantage of being harder.

Cannon, mooring bitts, cleats, chocks, ventilators, and all similar parts (Fig. 3) where there is nothing undercut, can be cast similarly in a two-part mold.

A high-grade anchor can be made from cut (square) copper nails with hammer and files. The stock is mortised into the crown and riveted securely at the end.

Cast cannon should be finished by hand, not in the lathe, which makes them too slick.

Davits. Iron davits for boats require careful making. The correct shape is shown at the left of Fig. 4. They taper from the sustaining band down to the socket and up to the top end, where there is a ball, bored vertically for an eyebolt in which to hook the fall block. Above the ball is a loose plate with two holes for the guys, and over it a nut. Davits are sometimes set inboard, but more frequently outboard.

Deadeyes. All sailing vessels except the more modern require a great many deadeyes, and upon the neatness of these depends to a great extent the appearance of the model. They must be uniform.

The easiest to make, but not the best, can be cut from celluloid rods such as knitting needles (Fig. 4). With a file or a fret saw, or in the lathe, cut grooves the right distance apart; then with a sharp knife slice off sections, each of which must have a groove in the middle. It is better to drill the holes, but they may be made with a hot needle. The flat sides should then be slightly rounded.

The best deadeyes are of boxwood or hard rubber. If you have a lathe, it is no great task to make them. They can be shaped with a parting tool, but it is better to make or buy a special tool, filed to the shape shown in Fig. 5 and hardened. This rounds, grooves, and cuts off in one operation. The drilling of the holes should always be done with a jig of the same general style as the one described below.

I am indebted to Fred Ritter for the following simple method of making deadeyes for those who have no lathe.

The boxwood stock should be turned or cut into round sticks or dowels of the required diameters. Take a piece of hardwood not less than ¾ in. square and 1 in. long and drill a hole straight through the center to form an easy fit for the dowel (Fig. 5). Another piece of hard-

To make blocks from a rectangular stick, the first step is to groove the two edges

wood ½ by 1¾ in., either round or square, is made with a hole through the center for the dowel. Drill a hole from one edge of this to take the locking screw. First insert a small plug, so that the screw will not mar the dowel; then insert the screw, which should have its point filed flat.

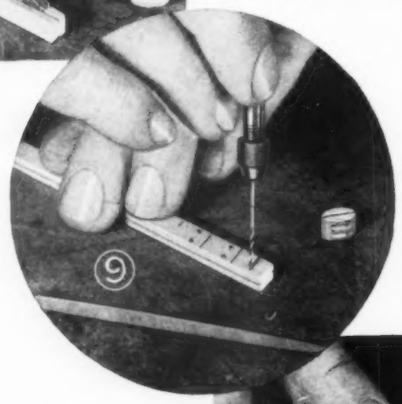
The block first mentioned should be clamped in a vise or otherwise held firmly. It can be made of any convenient size for fastening it firmly. Insert the dowel through both pieces until the end projects a shade beyond what is to be the middle of the deadeye. Fix it there by turning in the screw while both pieces are held tightly together. Now slightly crown, or round, the end of the dowel by holding a knife or file to it while turning the handle piece with the left hand.

Then with a knife held to the face of the square block, cut the groove, not too deeply and slightly V-shaped. Instead of a knife, a very fine hack saw, such as a jeweler's hack saw, may be used if the set is filed and then honed to a V-shape.

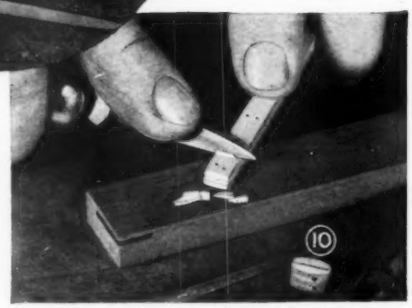
Move the dowel along to the desired thickness and mark another score. This is for cutting off, which may be done more easily after the whole stick is marked. A block may be fastened to the face of the square block to act as a gage. The cutting off must be done very gently or the wood will chip.

Move along for the next score, and so on. When all the deadeyes are cut off, the other faces should be crowned, although some model makers are content to leave flat faces on the insides of the deadeyes.

The drilling comes next. Various types of drilling jigs may be made. A simple one is shown in Fig. 6. One of the three main pieces of which it is composed is the retainer for the blank deadeye. It should be slightly thinner than the thickness of the deadeyes so that the deadeye will be held firmly when clamped against the base block. The hole should be just a trifle larger than the diameter of the deadeye. The master plate should be made of oak or some other hardwood, or brass. Lay out a circle the size of the deadeye and drill the three holes, properly spaced. Do this very accurately because all the dead-



The lengths are then marked off and holes drilled. In this case the blocks are double



At each of the dividing lines a V-cut is now made with a knife on the two opposite faces

eyes will be drilled to this pattern. This piece may be any reasonable thickness. The dimensions of the base are not important. Put a layer of glue along the edge of the face of the master plate and deadeye retainer, place them together so that the holes in one are exactly in the center of the hole in the other, and clamp them.

When the glue is dry, cut the notches and insert the two locking screw hooks in the base block. Two small strips may be glued to the top of the master plate so that when the jig is turned upside down for the insertion of a deadeye blank, there will be space for the hooks to be turned inward to clamp the whole jig together. Place the deadeye blank in this way and drill the holes through the master plate. It is suggested that a small pin vise and drill be used for this; such a drill will not split the wood and insures a clean hole.

WITH this set-up the deadeyes can be drilled in rapid succession, and all will come out much alike. The time spent in making the tools will be more than compensated, when one considers that the usual model has from 75 to 300 deadeyes. A complete jig will be needed for deadeyes of each different size.

Blocks. A tackle block can be made in many ways. The following is my method of making them by hand:

Boxwood is the best, but holly, gum, or other semihard woods will serve. They are easier to cut, but more inclined to split.

Suppose we are to make some blocks ⅜ in. in length. Cut an oblong strip of wood ¼ by 5/32 in. in section. For a double block, have the stick about a third wider, and increase its width proportionately for a threefold or fourfold block. With a V-gouge, knife, file, or marking gage, cut a groove right down the center of two opposite faces for the strap grooves (Fig. 7 and 8). Lay the strip down and mark it off at intervals of ⅜ in. plus the thickness of your finest saw. At one third of the length from each mark, bore a hole or holes of suitable size (Fig. 9). This size is just sufficient to take the cord that is to go through it, which is governed by the scale. For a block of this size, a No. 60 twist drill would be suitable.

FROM the grooves along the edges, with file or sandpaper, round the sides slightly all the way along. At each of the marks on both sides, make a V-cut with the knife (Fig. 10). Then saw the blocks apart. A fine fret saw or jeweler's hack saw is best.

Take each block between the thumb and finger of the left hand and with a very small file (a diesinker's three-cornered file is suitable) file the V-cuts at the ends into smooth curves, so as to make the narrow faces oval (Fig. 11). With the same file, continue the score for the strap around the ends of the block. With a V-gouge or the point of a knife, make a nick in the sides of the block from the holes to the heel (Fig. 12). This is to represent the opening or openings filled with a sheave (wheel).

Larger or smaller blocks are made in the the same way by increasing or diminishing all measurements proportionately.

The model supply houses, with their special jigs, dies, and machinery for making each part, can now manufacture some of them so well and so cheaply that unless one particularly wants to make each part oneself, it does not pay to do so.

Just a word of warning against using various odds and ends that have a vague resemblance to the parts required. A collar stud, for example, will always be a collar stud and never a capstan.

After the blocks have been sawed apart, the V-cuts are filed to the required oval shape

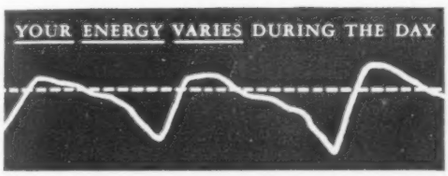
The final step is to nick the sides of the blocks slightly from the holes to the heel

Photo Bulb Reflector Taken from Heater

AMATEUR photographers who like to take pictures with artificial light at home but have no reflector, may use the reflector of an electric heater instead, if they have one with an exchangeable element. Just remove the wire guard, screw out the heating element, and put your photoflash bulb, photoflood lamp, or a bulb of 100 watts or more in its place. The reflector will shorten the exposure to one half or less of the time required without any reflector.—W. SCHMIDT.

A FACT!

SCIENCE ADVANCES NEW DATA THAT MAY COMPLETELY CHANGE YOUR IDEAS OF CIGARETTES!



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WHY, THESE TIRES ARE ONLY FOUR MONTHS OLD. THEY WON'T BLOW-OUT!
1
BUT BANG! THEY DID HAVE A BLOW-OUT
2
THE CAR WON'T STOP! LOOK OUT!
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EVERY YEAR THOUSANDS ARE KILLED OR INJURED IN BLOW-OUT ACCIDENTS
4

HERE'S REAL BLOW-OUT PROTECTION

New Goodrich Silvertown With Life-Saver Golden Ply Gives Months of Extra Mileage, too

EVERYBODY'S happy. Car running smooth as a top. Roads perfect. But, don't forget, it takes more than that to prevent a blow-out—especially if one of those tiny, treacherous heat blisters has started to form inside the tire. Then it's just a matter of time until BANG! A blow-out! And what starts out as a pleasure trip, often winds up in a wreck—or worse.

What causes blow-outs

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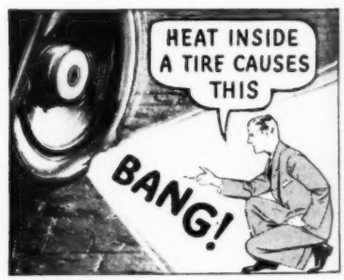
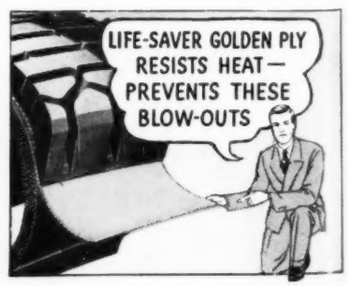
To protect motorists from blow-outs—to give you a tire that *will* stand up under today's high speeds, every new Goodrich Silvertown has the amazing Life-Saver Golden Ply. This remarkable invention resists *heat.* Rubber and fabric don't separate. Thus, blisters don't form inside the tire. The great, unseen cause of blow-outs is prevented *before* it begins. Isn't this evidence enough that this tire may save *your* life . . . will give you months of extra miles? And remember, this blow-out protection—plus longer wear—is really FREE! Because Goodrich Silvertowns—the only tires in the world with the Golden Ply—cost *no more* than other standard tires.





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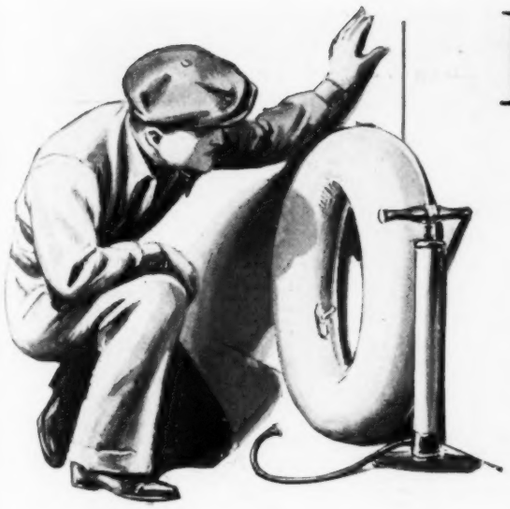
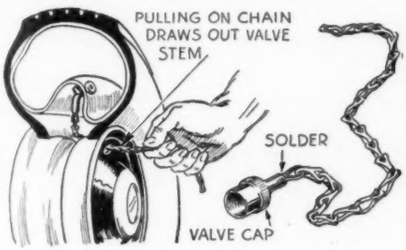
FOR MOTORISTS

Experienced Drivers Among Our Readers Offer You These Valuable Suggestions



WHEN no water is handy, it is sometimes difficult to determine whether or not an inner tube has a slow leak. A kink that the writer has found valuable in such cases is shown in the illustration above. The tube is inflated and rested against the wall. Then a pin is stuck into the wall above the tire so its head touches the top surface of the rubber. Even the smallest leak will cause the tube to sink away from the pin in five or ten minutes.—E.J.N.

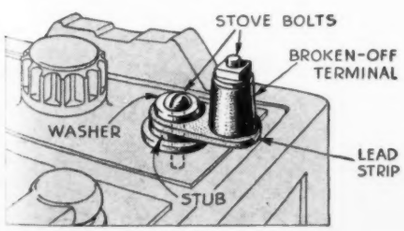


Replacing Tire Valves

OWNERS of cars equipped with so-called "air-wheel" tires may experience some difficulty replacing the valve stem in the rim when making tube repairs. To make the job easier, solder a short length of light chain to an extra valve cap. The cap then can be screwed to the valve and the chain pulled through the hole in the rim to lead the stem into place. The chain should be about a foot in length to allow plenty of slack. When not in use, the chain and cap can be stored on the valve of the spare tire.—F.L.C.

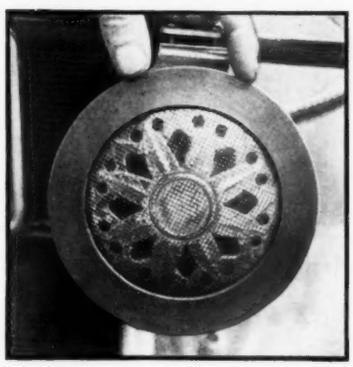
Broken Battery Terminal

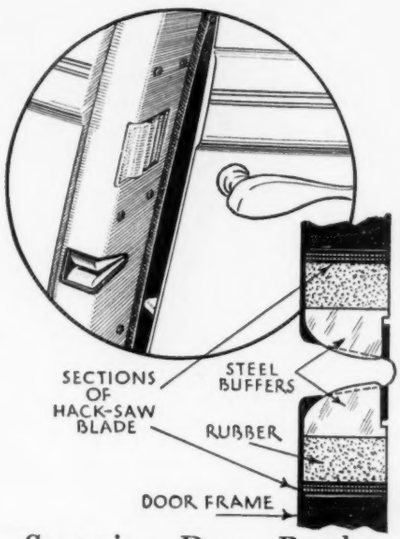
WHILE trying to loosen one of the cable clamps on my car battery recently, I accidentally sheared off one of the terminals. It had broken off so close, that not even a slight projection remained to serve as a terminal for the clamp. After trying several ideas without success I made the temporary terminal shown in the sketch. From a small sheet of lead, I cut a flat arm about 1 in. wide and 2 in. long. At one end I mounted the sheared-off end of the terminal with a stout stove bolt. Through a hole in the other end, I drove a second stove bolt into a hole drilled in the terminal base on the battery.—E.D.T.



Insect Shield for Horn

ORDINARY window screening and a soft rubber telephone base ring can be combined to form an inexpensive insect shield for the flat, open horns used on modern cars. Simply cut the screening to fit the front face of the horn, hold it in place, and slip the rubber ring in place over the rim. The ring will fit snugly and hold the screening tightly over the open face of the horn.—F.W.B., Jr.





Stopping Door Rattles

ANNOYING closed-car door rattles often can be silenced with small sections of discarded hack-saw blades. To make the repair, remove the steel buffers and rubber pads from the door jamb and place two shims of hack-saw blade steel between the jamb frame and the outer edges of the rubber blocks. The shims will reduce the clearance between the steel buffers and tend to hold the wedge-shaped projection on the door frame tightly in place.—C.H.J.

Soap for Squeaking Hood

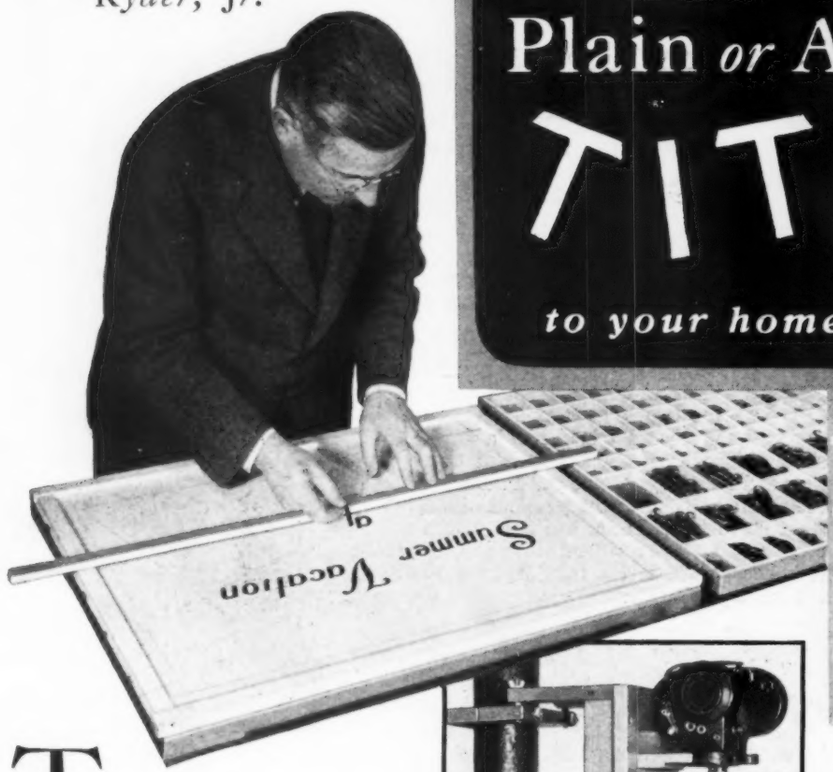
ORDINARY hand soap rubbed on the fabric lacings under the hood at the cowl and radiator frames will eliminate annoying squeaks and rattles that sometimes develop. Soap is better than grease as it does not collect dirt.—R.L.S.

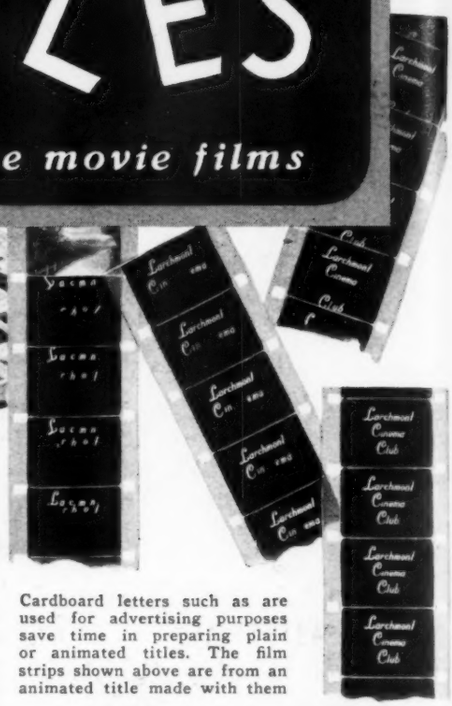
Rubber Gasket for Leaky Radiator Cap

IF THE radiator cap on your car fits loosely, allowing water to spray back on the windshield when the radiator is filled, remove the worn gasket and replace it with one made of rubber. Measure the inside of the cap with a drawing compass and then, with the compass, draw an inked circle on two thicknesses of live inner tube that have been cemented together. Wet the rubber for ease in cutting with scissors. The rubber gasket will give a perfectly water-tight seal that will last.—K.M.

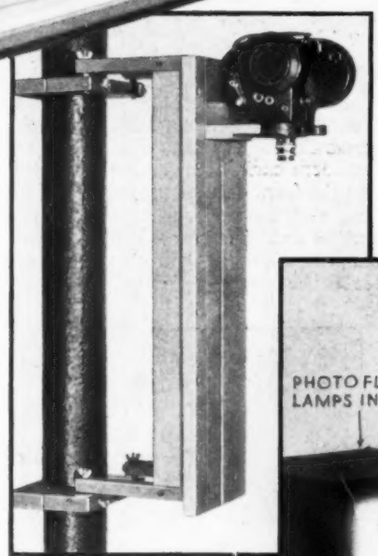
By *Frederick* D. *Ryder, Jr.*

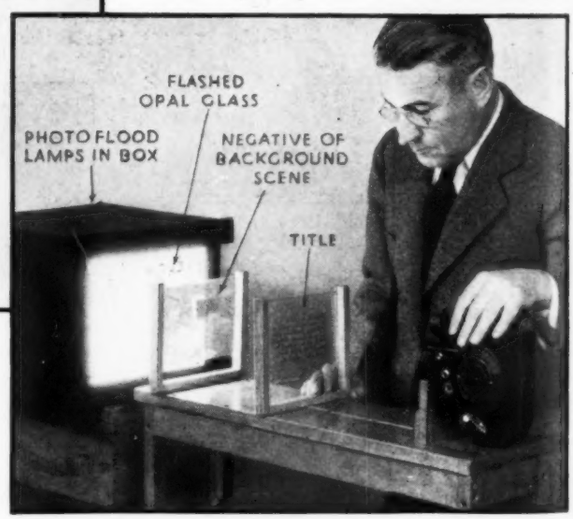
HOW TO ADD Plain *or* Animated TITLES *to your home movie films*





Cardboard letters such as are used for advertising purposes save time in preparing plain or animated titles. The film strips shown above are from an animated title made with them





TWO WAYS TO USE A TITLING STAND

Above: Homemade titling stand clamped to post in basement. ***At right:*** How the same stand is set up with a lamp box for use with negatives or other transparent backgrounds

"THAT'S the main street of Akron—no, Columbus—there's little George, Jr. when he was—how old was he when we took that, Marge?"

Do you exhibit your home movie films with this sort of "sound" accompaniment? It isn't necessary, and you are losing a lot of the fun of home movie making. To give your films the finished professional touch by adequate titling is both easy and inexpensive. In the years to come, the names, dates, and other specific information connected with the high spots of your vacations and trips will be kept fresh and unforgettable.

The simplest form of home titling is to use one of the special titling stands designed for use with your movie camera. These units are fitted with a supplementary lens which focuses the fixed focus type camera on the small card holder supplied with the device.

The titling stand illustrated in two photographs on this page is essentially the same thing except that it is made extra heavy and rigid, and a slot allows the card holders to be moved toward or away from the lens without getting them out of alignment.

Certain features are essential in any design of homemade titling stand. The most important is that the camera should be held tightly and in such a way that it will always occupy exactly the same position when placed on the stand. The second is that the location of the card holder should be fixed with equal accuracy. If these two requirements are not met, endless trouble will be encountered with unsightly, off-center, lopsided titles.

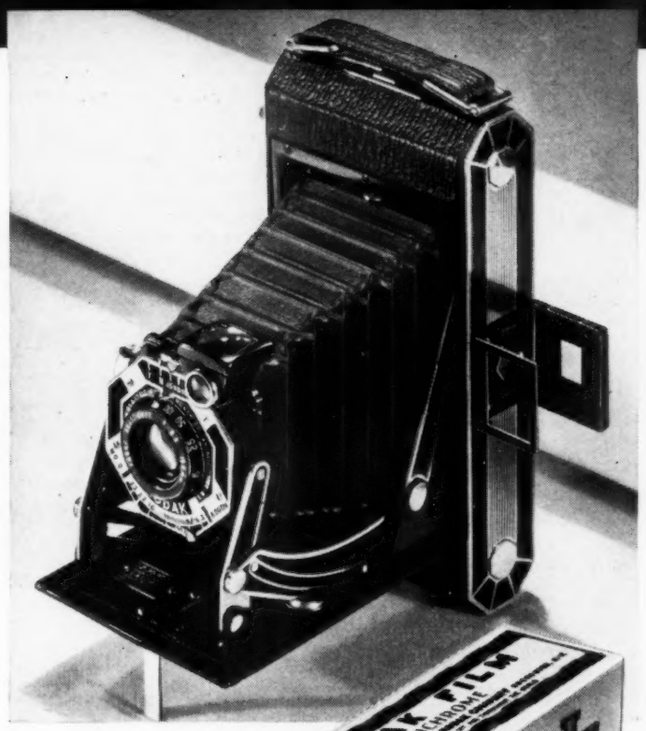
The mounting of an irregularly shaped camera such as is shown is much more difficult than to mount a rectangular box form camera. The latter requires only a pair of cleats nailed to the stand so that the camera will drop into place between them to be held by the tripod screw.

Tripod screws are ¼ in. in diameter with 20 threads to the inch (U. S. Standard), so that a suitable screw can be made by running a brass wing nut on a brass machine screw and soldering it in place.

It is entirely practical to make your movie titles on the film you use to take pictures. However, the regular panchromatic 16-mm. film costs four times as much as 16-mm. positive stock, which sells today for about $1.25 a 100 feet. At that price you can make a movie title on positive stock for about the cost of a postage stamp. And positive stock is exceptionally fine grained and gives clear, brilliant titles.

One thing you must bear in mind. If you make titles on regular reversible movie film, you get what you see. If you take them on positive stock, you get the reverse of what you see. In other words, with regular film you must use white letters on a black card if you want white letters against a black background on the screen. With positive stock, black letters on a white card *(Continued on page 92)*

Compare this 1934 Kodak with your present camera



The New Kodak Six-20 with *f*.6.3 lens

SOMETHING new in cameras . . . and here it is. Kodak Six-20 is the latest . . . sums up years of development . . . gives you new convenience, new style . . . new picture-making scope. Compact . . . it fits easily, snugly, in your pocket.

Touch a button—this camera springs into full picture-taking position. The fine Kodak Anastigmat *f*.6.3 lens gives you clear, sharp pictures in almost any weather.

Moving objects are easy to follow with the eye-level finder . . . and you can "stop" them in action with the split-second shutter. Success comes easy with the Six-20.

Finished in fine black-grained material and enamels—for 2¼ x 3¼ inch pictures, Kodak Six-20 with *f*.6.3 lens costs $17.50. Kodak Six-16 with *f*.6.3 lens, for 2½ x 4¼ inch pictures, $20. Other models from $14 up.

Fit your film to your subject.. *OUTDOORS* . . . use Kodak Verichrome—the film with a factor of safety. Verichrome has two coatings . . . one for shadowy details—another for brilliant high lights. *INDOORS* . . . use Kodak "SS" Pan—the film that's three times as fast as ordinary film under artificial light. With Photoflood bulbs, an *f*.6.3 or faster lens, and this fast film, you can make instantaneous exposures indoors . . . at night. *FOR ENLARGEMENTS* . . . use Kodak Panatomic—the film with a microscopic grain. Completely color-sensitive . . . amply fast—an ideal film for miniature cameras.

Snapshots at Night

The fast lens (*f*.6.3) lets you in on the latest indoor sport . . . snapshots at night. Two or three inexpensive Photoflood bulbs . . . a roll of Kodak "SS" Pan Film . . . and you're ready to make snapshots . . . indoors . . . at NIGHT.

A fine, fast miniature Kodak—low in price

This Kodak Vollenda—with its sharp-cutting *f*.4.5 Anastigmat lens . . . shutter speeds up to 1/100 second . . . focusing lens mount . . . eye-level finder . . . self timer—takes 16 pictures on a roll of "vest pocket" film. A big bargain in miniature cameras—it costs but $22.50.

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Mail this coupon today for your copy of the latest Kodak catalog. It gives you complete details about all the merchandise shown here . . . and lots more that you'll want to own. Mail to Eastman Kodak Co., Rochester, N. Y.

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IF IT ISN'T AN EASTMAN, IT ISN'T A KODAK

Adding Titles to Home Movie Films

(Continued from page 90)

give exactly the same result when projected.

The simplest title is plain, stationary white letters against a dark background. It is adequate for labeling places and people. If you have sufficient skill at lettering, you can prepare small cards with black drawing ink on white cards. Any decorations or fancy borders you choose to add will be perfectly reproduced by the fine-grained positive stock.

If you are a dub at lettering, or you want to make animated titles, the answer is to set them up with individual letters. One of the illustrations shows a title being set with cardboard letters such as are sold for making small advertising counter signs. The smallest size of these letters I have been able to find is 1 in., and they give clear titles at from 4 to 5 ft. A good trick is to nail a border strip around the title board so that a flat stick can be laid across in any direction to line up the letters without disturbing them.

After the title is set up, it is placed on a marked spot on the floor beneath the camera, which is supported, lens down, above it. The title stand may be bolted up near the ceiling to clamps on a column in the cellar, as shown. Wing nuts are used so that stand can be instantly removed for horizontal use. This gives exceptional rigidity, but equally good results could be obtained by bolting it to any firmly fixed partition.

INDIVIDUAL letters and a rigidly fixed camera allow you to make attractive animated titles. The camera is set for half speed, and the button is pressed and released quickly so that only one frame is exposed. Between each exposure the letters are moved a bit so they appear on the screen to rush on and form words all by themselves.

To show how this works out, let's follow the making of one animated title. The camera, wound up and loaded with positive film, is placed in position. A three-line title is set up, and the board is placed under the camera so that the title is upside down, so that if you looked through the finder it would appear bottom side up.

Now the lights are turned on the title board (photoflood bulbs are excellent for this work) and the camera is started at half speed with the lens at the wide open position (F/1.9 or better) and the diaphragm is turned smoothly to stop F/4.5 or smaller—the stop, in other words, that a previous test has shown to be right for the light used. The camera is kept running while the title is read through twice, slowly, and is then stopped.

Start the animation by moving the lower line of letters about ⅛ in. toward the edge of the board. Give the release button a quick press, move the letters another ⅛ in., press the button again, and so on until you have, in successive stages, removed all the letters from the field of the lens. Then let the camera run for another two or three seconds.

Spliced into your film so that it runs through the projector in the opposite direction from that in which it was taken, the start of the title appears as a plain black background and the letters then float onto the screen line by line. The title remains stationary for adequate reading, but when the point is reached where the lens was closed down from the open position of the diaphragm, the reverse effect takes place—that is, the increasing exposure gradually darkens the whole film till the terrific overexposure given by F/1.9 less) causes even the letters themselves to go or better (when the light calls for F/4.5 or black.

The reason for reversing the operation when exposing the film is that it is much easier to animate letters off the board than it is to animate them on and get them to come accurately in line and properly centered. Illustrated at the beginning of this article are some sections from a film title that was animated in just this way. Of course, if you haven't a fast lens and plenty of light on the title board, you'll have to eliminate the fade-out.

All sorts of variations are possible. You will find it fascinating to work out figured backgrounds, transparent celluloid overlays carrying part of the lettering, and so on.

One of the illustrations shows the titling stand set up for use with transparent titles instead of ordinary card titles. This arrangement enables lettering to be superimposed over photographic or drawn backgrounds.

Some photoflood bulbs in a box with a window made of flashed opal glass give excellent illumination. In one holder, at the shortest distance to which your lens can be focused, place a negative of the scene you want for a background. This can be an

Title strips on positive stock may be developed in two large bottle

actual camera negative or a substitute consisting of a pencil drawing or tracing on thin white tissue paper. The lettering is done on a transparent piece of celluloid and is placed in the other sliding holder.

You can get a "zoom" effect by starting the camera with the lettering holder close to the lens and then smoothly sliding it down the board into contact with the background holder. On the screen this makes the letters appear to come past the camera and hit the screen. Here, too, all sorts of interesting variations are possible and easy to work out.

GETTING your titles squarely centered on either the title board or a small card is easy if you check your camera and holders with a test chart consisting of sheet of paper ruled into squares with black ink. A large black dot should be placed in the center and the word "top" placed halfway out from the center. Shoot a few frames of film of the test chart. With the aid of a magnifying glass you can count squares on the film image and see how far you are off center. Make corrections and try again. When you have it right, mark the position of the test chart.

The developing of titles taken on positive stock is extremely simple as I have it worked out. All the apparatus you need is a darkroom lamp (the bright orange light that is safe with bromide enlarging paper is safe with 16-mm. positive stock), two one-gallon bottles, a package of X-ray developer powders suitable for a gallon solution, and a couple of pounds of the prepared acid hypo solution.

Dissolve the developer in one bottle and the hypo in the other, and you are all ready. When you have shot a title, take the camera in the darkroom, open it, and with a pair of scissors snip off the exposed film. "Dunk" it in the bottle of developer for five minutes, pulling it nearly out once every minute; then wash it for thirty seconds or so in the wash basin and "dunk" it again, this time in the hypo. It will clear in two minutes or less and should then be washed in running water in the basin for ten minutes. Wipe off the surplus water with piece of damp cotton and hang up. It will dry and be ready for splicing in from fifteen minutes to an hour or two, depending on the dryness of the air.

As the developer will keep for months in a filled, well-corked bottle, and the hypo likewise, this system of development is no trouble at all. I have handled titles up to 10 ft. long by this method.

Remember that positive stock must be opened and handled entirely in the darkroom by the aid of the orange light. It comes in a sealed can in a roll. You can spool it on a discarded 100-ft. film reel and keep in the tape-sealed can when not in use.

MAGIC BEAM OF LIGHT

(Continued from page 73)

nected just as when the radio is in use.

One characteristic of selenium might be mentioned. If it is kept at a temperature of 200 deg. F. for half an hour and then allowed to cool slowly, its sensitivity will be increased.

The transmitter is even easier to make. A beam of light issuing from the lamp house and its 60-watt bulb is concentrated on the square of mirror. The glass is cemented to a sheet of very thin metal mounted over the sound box. The latter, which is shown clearly in two of the photos, consists of two thin pieces of wood with a hole cut through both. The larger piece is fastened to a block that rests on the baseboard and is clamped with a central bolt and wing nut.

Speaking into the mouthpiece causes the mirror to vibrate in the same manner as any standard telephone transmitter. By directing the beam of light reflected from the mirror across a room so that it falls on the selenium cell or photo-electric cell, whichever is used, anything spoken into the transmitter is reproduced by the radio loudspeaker with great clearness.

In practice it is best to focus the condensing lens in front of the lamp house so that it shows an image of the lamp filament on the mirror. The latter may be made more sensitive by drawing fine black lines across it horizontally, spaced as far apart as the strips of brass in the selenium cell. The talking beam of light is not difficult to adjust, however, and will furnish many hours of entertainment and scientific amusement.

PORTABLE PICNIC TABLE

(Continued from page 76)

4 ft. 5 in. After this, the frames are set up and the top sections put in place, followed finally by the seat supports. Be sure that the frames are straight up and down. Bore the ⅜-in. holes as shown, and insert a bolt in each hole as soon as it has been bored. The seat boards are then made. A hole may be bored through them and into the seat rests, if desired. A small bolt dropped into the holes will keep the seat boards from moving about.

Before dismantling the table the first time, number the four top sections as shown, also one of the frames to correspond, as well as one end of each seat support. By doing this, it is an easy matter to get the different parts of the table in their right place each time by comparing the numbers.—J. P. KNIPP.

TRAYS MADE WITH ANIMAL HANDLES

(Continued from page 77)

three thicknesses of 3/16-in. plywood. They are sanded and stained light mahogany except the underpart of the neck, the belly, and the tip of the tail, which are left the natural wood color, and the legs and ears, which are colored with black ink or some other black stain. Black glass-headed pins are set in for eyes. Their feet are then glued in the dovetail openings with waterproof casein glue. Small C-clamps are used to bring the outside feet slightly inside the outer edge of the molding while the glue dries. A good mixture for filling in between and outside the feet is, roughly, fifty percent by volume of waterproof casein glue powder and fifty percent sawdust, mixed together before adding cold water. Some shrinkage will occur, so it is necessary to add a second coat of this mixture before sandpapering and painting the frame.

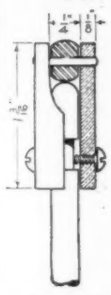
It will be found advisable to give the completed tray, handles and all, two more coats of spar varnish.

SMALL DRILL PRESS

(Continued from page 80)

the frame. Clean the wires thoroughly and cover each with a thin coat of soldering flux. The ends of the wires that have a tendency to sag can be supported with slender splints of wood or broom straws, which will burn out as the hot metal enters the mold. The wires should be kept as near the center of the mold as possible. After removing the casting from the mold, the projecting ends are cut off and filed flush with the surface.

After the castings are smoothed up, and not before, the rod which was used as a core should be removed and the bearings ground out slightly with fine emery and oil. The two castings are assembled by means of a ¼-in. machine screw placed up through the recess in the base and forced into a hole in the frame.



The bearing at top of spindle

The cap or bearing at the upper end of the spindle is shown in the accompanying detail. This is cut from a ¼-in. (inside dimension) brass tube having ⅛-in. walls. Two holes are drilled and tapped for set screws which fit into the groove at the upper end of the spindle, allowing the feed lever to raise and lower the drill. In the absence of a tap of the proper size, the steel screws may be forced into the holes, the screws forming their own threads as they enter the brass. This method of tapping a hole may not be orthodox, but it works.

The link between *D* and the feed lever is made of two pieces of 3/32-in. iron bar, 5/16 in. wide and 2½ in. long, with ⅛-in. holes drilled at each end. The lever itself is a 5/16-in. rod fitted with a handle taken from an old wood-carving tool.

A coil spring to raise the drill point should be inserted between the feed lever and the frame. The lower end is held in a hole in the frame, and the upper end held in place with a clamp placed around the feed lever.

The drill is adjusted by inserting a wire in the chuck, the wire being bent to form a right angle just above the drill table. As the spindle is turned, any variation in the height of the outer end of the wire above the table should be corrected by inserting thin brass shims between the drill frame and the base.

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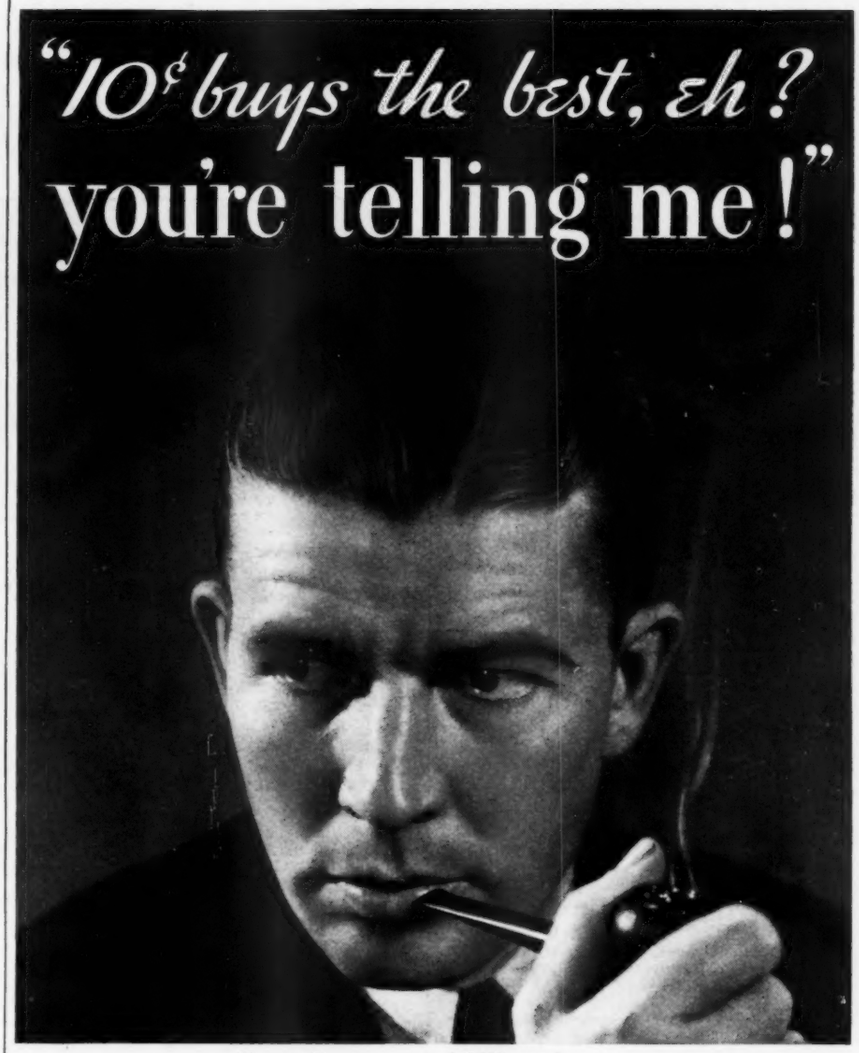

BRUCE CABOT . . . noted RKO movie star

"HELP YOURSELF," said a friend as he passed me his tin of Union Leader. "You probably won't believe it, but that tobacco cost me only a dime."

Which goes to show that *"price"* isn't the only measure of *value*. That first pipeful of Union Leader won me . . . and I've been smoking it ever since.

In Union Leader your dime buys the sweetest and smoothest Kentucky Burley that ever glorified a pipe. A pipeful will prove that. (P. S. It's mighty fine for cigarettes, too.)

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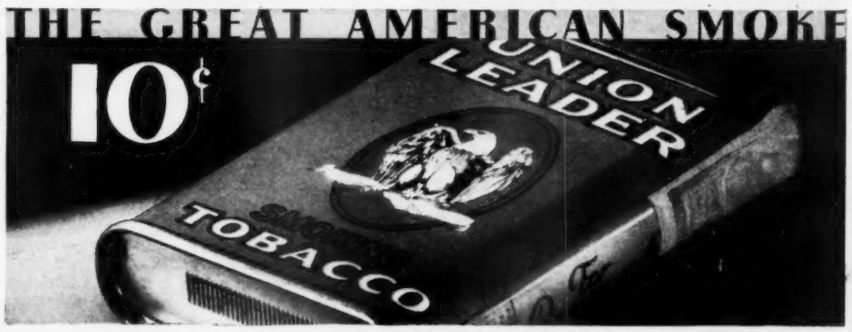
UNION LEADER

THE GREAT AMERICAN SMOKE



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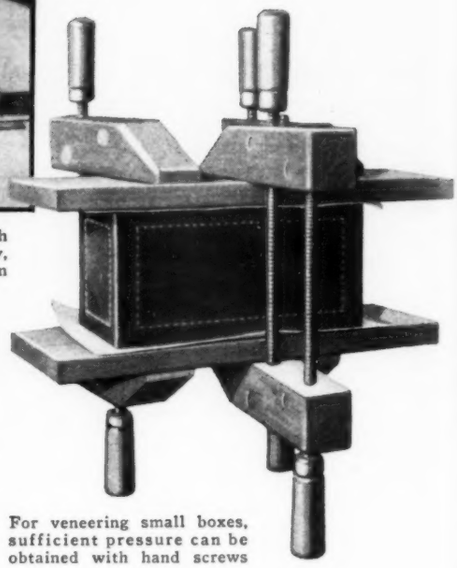
Herman Hjorth tells how easy it is to make

BEAUTIFUL *Veneered Boxes*

Veneers are cut on any flat surface, such as an old drawing board, with a veneer saw, shown above, or a heavy knife or plane iron



For veneering small boxes, sufficient pressure can be obtained with hand screws

SMALL, decorative boxes for playing cards, sewing, jewelry, gloves, collars, cigars or cigarettes, and make-up, may easily be made by the home craftsman. The most interesting and artistic way of decorating such boxes is by means of veneering.

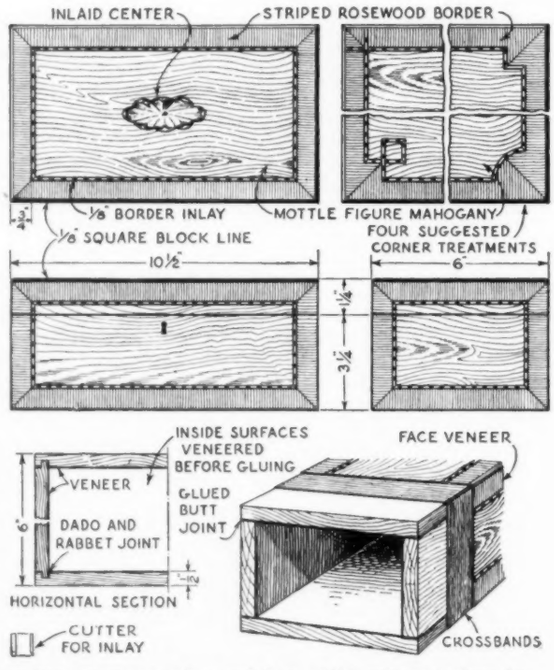
The first step is to get out the material for the sides and ends. Use some softwood as Philippine mahogany, whitewood, or cypress. After being squared, these pieces are veneered on one side so that the grain of the veneer runs at right angles to that of the solid wood. Inexpensive straight-grained mahogany veneers, called crossbanding, may be used for this purpose.

Cut veneers on a flat surface, using a steel square for a straightedge and a veneer saw, a strong knife, or a thick plane iron. The strips should be ½ in. wider and longer than the finished dimensions. If two strips must be joined, the edges are planed by clamping them between two hardwood boards. They are then fastened to a board with fine brads and taped together with gummed paper strips.

The veneers are now ready for gluing. Use a stainless casein glue and apply it to the solid wood only. Fasten the veneer with a couple of fine brads and cut their heads off ⅛ in. above the surface. The taped side of a joint should always be up. Cover the veneer with a piece of newspaper and place the other side on top of the first one. Press down on it so that the projecting ends of the brads enter the wood. Glue the veneer to the second side in the same way and clamp the two sides between two straight, soft boards. Veneer the ends in the same way. When dry, remove the brads, trim off the projecting veneer, sand the surfaces, and make the dado and rabbet joints in the corners. Glue the sides and ends together, being careful to check for squareness.

The top and bottom are also veneered across the grain, but on both surfaces of each piece. When gluing and clamping, place a third board between the two pieces. After trimming the edges of the veneer and sanding it, glue the top and bottom to the sides and ends.

When the glue is dry, the sides and ends are planed perfectly smooth



How to veneer a box and four additional suggestions for corner treatments. Cutting off the lid is the last step

and crossbanded as explained before. The two sides are veneered at the same time, and then the two ends.

The box is now ready for the face veneers. These may be made up in any number of ways and from many different species of wood. For the beginner, a panel with a border around it is about the simplest. Lay out the panel and border directly on the surface to be veneered. Clamp the panel between two hardwood boards, plane its edges and ends to exact dimensions, and tack it to the box with fine brads. Cut the strips for the border about ⅛ in. wider than needed and join them side to side. Plane one end, lay out

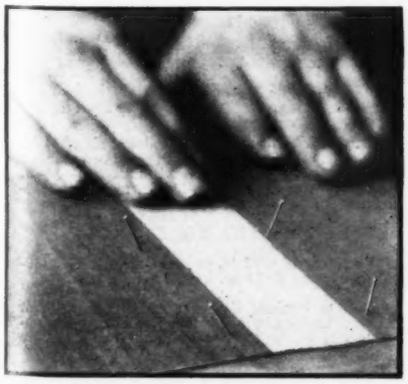
Planing the edges of veneers that are to be joined. They are clamped between two boards

and cut the miter joints, and tape the border to the sides and ends of the panel. Glue the face veneers to the ends first, then to the sides, and finally to the top. They should be fastened with at least four brads each to prevent them from sliding.

Lines and insets may be obtained in different widths and patterns from manufacturers of marquetry. The easiest way to cut grooves for them is with a machine and a router bit, but it may also be done by hand with a home-made steel cutter, which may be used in a marking gage. Since some of the veneer must be cut across the grain, the outlines of the groove must first be cut with the spur of a marking gage filed to a knife point. The groove for the square black line around the top edges is made in the same way. The black lines are held in place with strips of gummed paper while the glue sets.

When dry, the inlays are scraped flush with the surrounding surfaces, after which the box is given a thorough sanding. It is then cut open with a fine back saw, guided by two strips clamped on each side of the gaged line. Smooth and stain the edges and apply the hinges and lock.

In most cases the veneered surfaces should not be stained. Apply a thin coat of paraffin oil, obtainable in any drug store. Let the work dry for twenty-four hours, wipe thoroughly, and apply three or four coats of very thin shellac. Let each coat dry about four hours and then sand it with No. 3/0 sandpaper or steel wool. Finish the last coat with No. 7/0 waterproof sandpaper and paraffin oil.



The joining pieces are fastened to a board with small nails, and paper tape is applied

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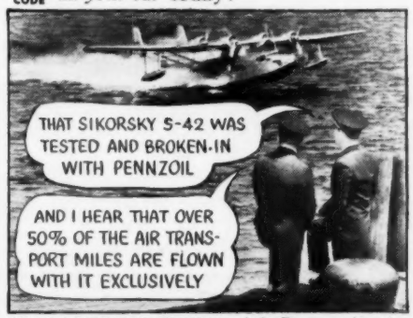
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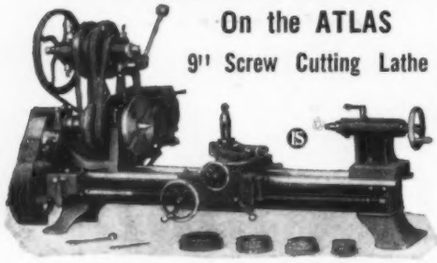

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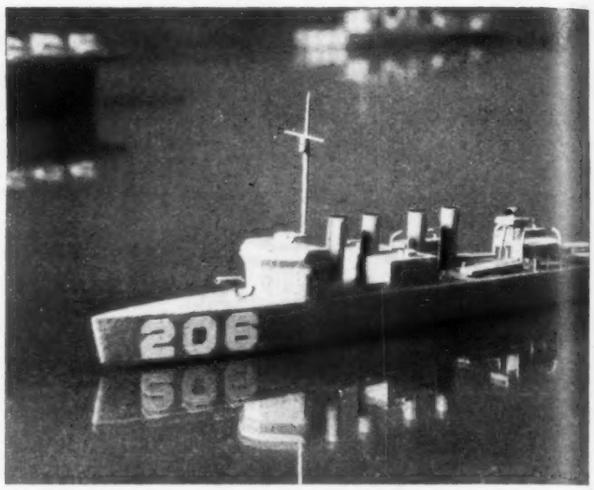
HISTORIC UNITED STATES SHIP MODELS

(Continued from page 71)

the triangular notches (dotted lines) on sides of the indentations just mentioned. Insert copper washers in position. With plastic wood composition, a mixture of thin cellulose cement and wood file dust, or similar filler, fill in steps at bow. Shape and sandpaper to a smooth concave surface (see cross section diagrams). Paint entire unit (except topside) gray.

Cut paper to shape of piece *D*. With yellow pencil draw two lines a scant ⅛ in. wide and spaced 1 in. apart from stern to aftermost turret. Continue them ⅝ in. apart to bow. Draw a circle of ¾-in. diameter, with center 2 in. from stern. Glue paper to *D*.



This striking photograph shows that these miniature models, easy as they are to construct, are extraordinarily realistic

Make complete superstructure before attaching to hull. File grooves for pins in piece *E*. Bend ten pins *Pn* and glue in place, covering them with card *F* to hold in place. Shape piece *G* by rounding sides after getting necessary slant. Shape piece *I*, file the groove, and insert this part in the notch as indicated. Glue split bamboo strips *(BS)* into place as shown in the drawing of *G*. Shape pieces *R* to *V* and glue *R* in position on bamboo strips; mount the others in turn. Shape pieces *J* to *P* and glue *K* to *J*, *L* to *K*, and so on. The plans show all distances for spacing. Insert tripod mast legs through holes in *K*, using drop of glue to hold them at the correct angle. Fasten the upper mast at *N* and *P*. *(Continued on page 97)*

List of Materials

NOTE: Except where otherwise specified, all material is balsa wood of the type universally used in model airplane construction.

SARATOGA

No. of Pieces	T.	W.	L.	For
1	1/2	2	17 13/16	A
1	1/4	1⅛	1¾	G
1	1/4	¼	⅜	I
1	1/4	⅜	⅝	J
1	3/16	¼	¼	M
4	3/16	¼	½	W
1	1/8	¼	4¾	E
1	1/8	7/16	¾	K
1	1/8	⅛	⅛	O
2	1/8	3/16	⅞	LB1
9	1/8	5/32	⅝	LB2
1	3/32	2	17 15/16	B
1	3/32	2	17 31/32	C
1	1/16	2	17 27/32	D
1	1/16	3/16	5/16	N
3	1/16	½	⅜	R, T, and V
1	1/16	¼	5/32	S
1	1/16	⅛	⅛	U
1	1/32	¼	5/16	P
2	1/32	1/16	¼	Q
1	1/32	5/16	1 11/16	H
1	1/8	¼	½	L
2	1/64	1/64	2¼	Split bamboo for BS
2	1/64	1/64	1¾	"
2	1/64	1/64	⅜	"
2	1/64	1/64	⅛	"
4	1/8 rd.		1/16	Dowel for X
3	1/8 rd.		3/32	Dowel for Y
2	1/16 rd.		1/16	Dowel for Z
16	1/4 dia.			Washers AAG (12) W (4)

Plain pins, which can be cut down from any larger sizes to the following lengths: 3 of 1⅛-in. length for Tm; 8—¾-in., for guns W; 2—⅝-in. for Dr; 10—½-in. for Pn; 1—¼-in. for F1.

T-pins, 12 of size No. 0 for AAG.

Eyelets, 12 of 1/32 in. inside diameter with 3/32-in. flange and 3/32 in. long, for AAG.

One card ⅜ by 2⅝ in. for F.

Brown paper 2 by 18 in. for deck.

Glue or cement; light gray and black paint or colored model airplane "dope"; yellow pencil for drawing stripes.

For airplanes use 1/16 by ⅛ in. balsa for fuselage, split bamboo for propeller, and card for wings, rudder, etc.

DESTROYER

No. of Pieces	T.	W.	L.	For
1	3/8	⅝	6¼	A
1	3/16	⅝	7/16	B*
1	3/16	⅝	⅜	D
1	3/16	¼	½	G
1	1/8	⅝	7/16	E
3	3/32	⅛	½	L
2	1/16	1/16	9/16	C*
1	1/16	3/16	¼	F*
2	1/16	3/32	⅛	J*
2	1/32	1/16	9/16	H*
2	1/32	3/16	5/16	I*
1	1/32	⅛	⅛	K*
4	1/32	⅛	3/32	Q*
1	1/8 dia.		½	Dowel for M
3	1/8 dia.		11/16	Dowel for N
1	1/16 dia.		1/16	Dowel for O*
12	1/32 dia.		1	Reed for P*
1	1/32 dia.		⅛	Reed for V*

Pins with heads removed as follows: six of ½-in. length for R; 6—½-in. for S; 2—½-in. for Y; 2—¾-in. for T. Pins with heads left on: 4—½-in. for U. Pins or needles: 1—1¼-in. for X; 1—1⅞-in. for W.

T-pins, 2 of size No. 0 for Z.

Eyelets, 2 of 1/32-in. inside diameter with 3/32-in. flange and 3/32 in. long, for Z.

Glue or cement; light gray and black paint or colored model airplane "dope"; white paper numerals ¼ in. high (or white paint if numbers are painted on).

Items marked with asterisk (*) require no further cutting or carving.

This seal on an advertisement signifies the approval of POPULAR SCIENCE INSTITUTE OF STANDARDS.

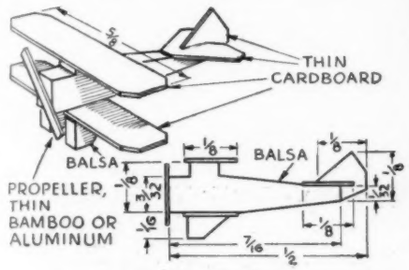
HISTORIC SHIP MODELS

(Continued from page 96)

Cut the required *X* and *Y* pieces from a dowel and fasten in place. Shape pieces *Q*. Attach *Z's* to *Q's* and fasten to *G*. Shape turrets *W*. Insert pins cut to correct length for guns after drilling holes to avoid splitting wood. Attach washers to underside of turrets. Fasten two of the turrets to *E* as indicated. Hold others for final assembly. Shape the two large and nine small boats. Remove heads of two pins and make crane *Dr*. Paint all parts made thus far a battleship gray color. Round the corners of *H* and paint it black.

Commence assembly by inserting boats into recesses in hull. Attach the three boats alongside funnel. The entire superstructure, except two turrets and the crane, is now in one piece, so glue it in position on hull. Glue the two single turrets to hull and insert *Dr* ahead of foremost turret. Glue *H* to *G*. Insert pin *Fl* at the angle shown into *G*.

With pliers cut a portion of one side of the head of twelve T-head pins. Slip pins through eyelets, then through the washers already glued to hull, to form the anti-aircraft guns *(Aag)*. If your model is to be the *Saratoga*, paint a black stripe about 3/16 in. wide down both sides of the funnel *(G)*, and thin stripes down the length of the turret tops; if the



The airplane models are, of course, smaller than these drawings and do not look so crude

Lexington, paint a black band 1/8 in. wide *around* the funnel directly under *H*.

Though seventy planes are carried, all are not always on deck at one time, and a squadron of eighteen gives a sufficiently complete appearance to the finished model.

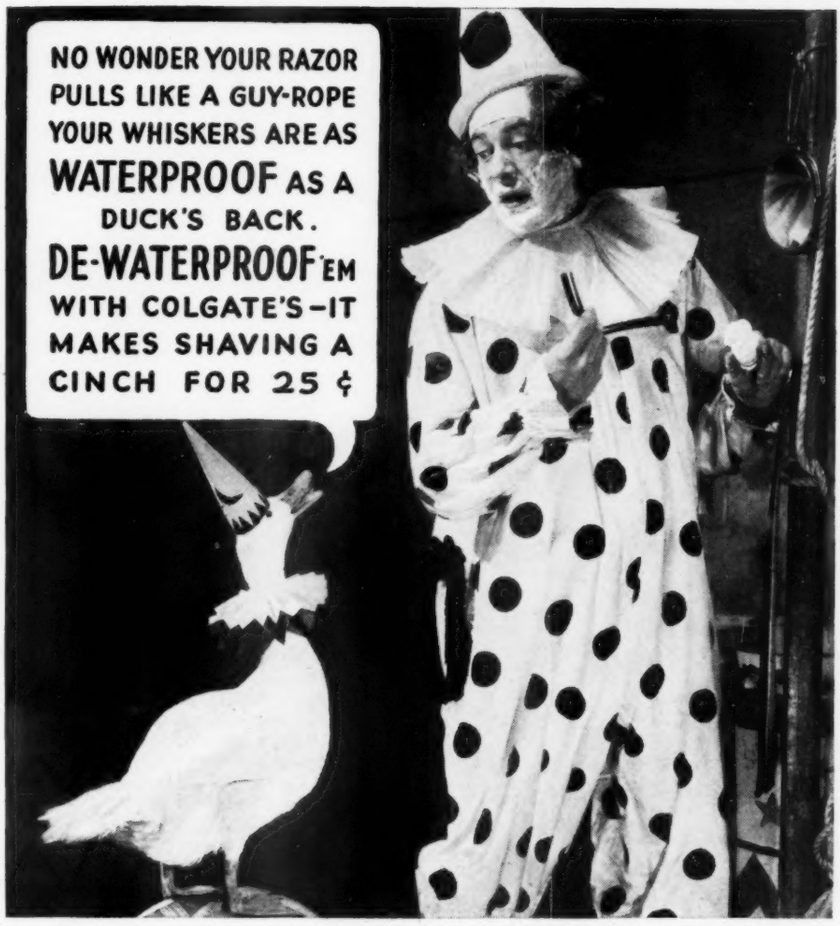
The *Saratoga's* convoy consists of destroyers. For the purpose of this historical series, it will be sufficient if you build one destroyer model, but it is better to make four because, although often employed singly, their formation in the fleet is in groups of four. These so-called "flush-deck" destroyers are so numerous and useful that their doings constantly appear in the news. Two hundred and seventy-three were built to help win the war, but in another five years they will all be gone. New ships of this type now under construction will replace them.

Begin by carving the hull *A*. Since the deck is not parallel to the water line, cut down the block so that it is 3/8 in. thick at one end and 3/16 in. thick at the other. Be sure to keep all surfaces absolutely straight and square. Following the plan, taper the block correctly from bow to stern, giving a slight flare to the bow and a tumble home to the stern in the final sandpapering.

Mark lightly on the deck surface, after careful measurement, the location of pieces *B*, *D*, *G*, and *I*. Cut the corners off pieces *D*, *E*, and *G*. With a razor blade, shape the pointed forward edge of *E* as indicated. Glue *B*, *C*, *C*, *D*, *E*, *F*, *G*, *H*, *H*, *I*, *I*, and *J*, *J* in their correct positions, taking off the distances from the plan.

Make funnels by tapering the end of pieces *M* and *N*. Locate the centers of the funnel positions on *A* and *B*.

With a sharp nail or *(Continued on page 99)*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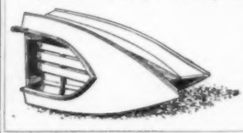

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NOTE: Full-size patterns for any boat marked with an asterisk (*) will be drawn to order for $1.50 extra. Simply add this amount to the cost of the blueprints. About one week is required to fill orders for patterns.

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Amateur Short Wave Receiver, *155*	.25
Amateur Radio Transmitter, *183-184*	.50
Amplifier, Three-Stage, Audio-Frequency, *42*	.25
Five-Tube Short Wave Set (A.C. or D.C.), *223*	.25
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One Tube (battery operated), *103*	.25
Screen-Grid Set, *109*	.25
Short-Wave Converter Unit, *137*	.25

SHIP AND COACH MODELS

(Construction kits are available for some of these models. Send for list)

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Battleship—U. S. S. *Texas* (3-ft. hull), *197-198-199-200*	1.00
Bottle, Clipper Ship in, *121-122*	.50
Clipper, Baltimore (8-in.), *92*	.25
Clipper Ship (20½-in. hull), *51-52-53-R*	1.00
Clipper, Simplified (9½-in. hull), *219*	.25
Constitution (21-in. hull), *57-58-59-R*	1.00
Cruiser *Indianapolis* (12 in. long), *216*	.25
Destroyer—U. S. S. *Preston* (31¼-in. hull), *125-126-127-R*	1.00
Galleon *Revenge* (25-in.), *206-207-208-209*	1.00
Galleon, Spanish Treasure (24-in.), *46-47*	.50
Hartford, Farragut's Flagship (33½-in. hull), special prints *221-222-R*	1.50
Mayflower (17½-in. hull), *83-84-85-R*	1.00
Miniature Coach and Covered Wagon for Decorating Boxes, etc., *202-R*	.50
Motorboat, 29-in. Cruiser, *63-64-R*	.75
Motorboat, Working Model (20-in.), *196*	.25
Liner—*Aquitania* (9-in. balsa wood model made very simply in layers), *225-R*	.50
Liner—*Manhattan* (12 in. long), *204*	.25
Pirate Galley or Felucca (20-in.), *44-45-R*	.75
Roman Galley (19-in.), *138-139-R*	.75
Sails—Square and Fore-and-Aft for Whaler *Wanderer* or any Model, *185-186*	.50
Santa Maria (18-in. hull), *74-75-76-R*	1.00
Schooner — *Bluenose* (17½-in.), *110-111-112-R*	1.00
Sedan Chair, Queen's (12-in.), *123-124*	.50
Stagecoach (20½-in.), *115-116-117-R*	1.00
Stagecoach (Cody), with horses (coach body 13 in. long), *144-145-146-R*	1.00
Steamboat, Mississippi (19½-in.), *94-95-96-R*	1.00
Viking Ship (20½-in.), *61-62-R*	.75
Weather Vane, Ship Model (30-in.), *66*	.25
Whaler—*Wanderer* (20¼-in.), *151 to 154*	1.00
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Yacht (20-in. racing), *48-R*	.50

MISCELLANEOUS

Doll's House, Colonial, *72*	.25
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Perpetual Star Chart, *214*	.25
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Toy Airplane Cockpit with Controls, *114*	.25
Toy Birds and Animals, Jig-Sawed, *56*	.25
Toy Drill Press, Lathe, Saw, etc., *113*	.25
Toy Dump Truck, Fire Engine, etc., *101*	.25
Workbench, *15*	.25

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HISTORIC SHIP MODELS

(Continued from page 97)

⅛-in. drill, if available, start holes for the funnels. Insert the tapering point and drive into hull by tapping lightly with a hammer. Note that the funnels are perpendicular to the deck line. The rake is due solely to the slant of the deck line.

Construct the searchlight tower by inserting four ½-in. pins into the hull between pieces *I*. Placing drops of glue on the heads of pins, attach *K*, then *O* to *K*. Make torpedo tubes by attaching three ½-in. pieces of 1/32-in. reed to each piece *Q*. Glue the units thus made into the places designated in the plan.

Bend six pins into shape *R* and six more into *S*. Insert into the hull as indicated, keeping them as near the edge as possible without splitting the wood. Carve the three boats *L*, and with drops of glue attach them to supports *S*.

Bend pins *T* and insert in hull to form the propeller guards. Insert masts *W* and *X*, making certain they are perpendicular to the *deck line*, not the water line. Attach small piece of 1/32-in. reed *(V)* to *W* for the crow's nest. Remove heads from pins *Y*, bend in center at right angles, and insert into *J*.

With pliers, cut a portion of one side of the head of two T-pins. Slip them through eyelets and insert into the hull to form guns *Z*.

Paint entire model gray. When dry, touch the tops of the funnels and the round sides of searchlight *O* with black ink or "dope."

The distinguishing numerals at the bow, so characteristic of these vessels, must not be omitted. Since painting them neatly offers much difficulty, a practical solution is to affix gummed paper numerals ¼ in. in height, obtainable at most commercial stationers. Altogether more than 200 of these vessels were built. To carry out the idea of a division of four ships, it is best to give the models consecutive numbers, for example, 206, 7, 8, and 9.

Models to Come

THE most famous United States warships and merchant vessels will be included in the new model-of-the-month series. Next month—the *St. Louis* and *St. Paul*, historic liners of the nineties, which have a service record in two wars. Models of the *Savannah*, which was the first steamship to cross the Atlantic, the *Monitor*, the frigate *Constitution*, and a number of other ships that have made history are on the schedule.

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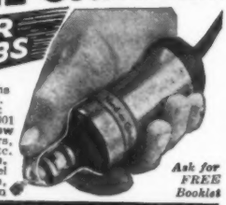

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OUR NEW GENERAL UTILITY ROWBOAT

(Continued from page 86)

planking at the outer end. The cut will be on the outside of one plank and on the inside of the other. Allow 1 in. for plank lap.

Coat the stem rabbet, transom, and chines, with "C" quality marine glue. To prevent splitting the side planks at the stem, wrap the forward ends in sacks and pour on scalding hot water.

Clamp the plank in place and fasten to the frames, stem, and chines with 1¼-in. No. 8 F.H. screws spaced at 2½-in. intervals. Fasten the other side similarly. The planks next to the clamp piece are now fitted. Before fastening them, coat the lap, stem rabbet, frame edges, and clamp with marine glue. Fasten the lap together and fasten the plank to the clamp with 1¼-in. iron or copper clout nails, spaced 2½ in. on centers, clinching nails on the inside. Drill lead holes for all nails and screws.

IF CONSIDERED desirable, short lengths of planking may be used at an angle to make an easily built but stout bottom by the alternative method shown on the plans. The regular lap-strake bottom planking, however, is attached as follows: The two center planks are the only ones requiring fitting. Mark a center line on the keel. At frame No. 3 clamp the first plank in place so the edge is even with the center line. The forward and after ends will overlap. Measure, mark, and saw off the surplus so the plank edge fits even with the center line. Bevel the center seam edges and allow a 1/16-in. seam. Clamp the plank fore and aft, edge even with center line, and mark each frame along the outside edge. Remove the plank and make a saw cut ⅜ in. deep on the outside frame mark. Chisel out the frame and transom notches as shown. Cut the plank notch at frame No. 1 to a depth of 3/16 in. Coat the keel, transom, and chines with marine glue. Clamp planks in place and fasten to the keel, chines, frames, and stem with 1¼-in. No. 8 F.H. screws, spaced 2½ in. apart. The forward ends of the planks are lapped in a manner similar to the side planks. Countersink screws along the keel to allow for planing so the skeg will fit evenly.

Fasten the remainder of the planking in like manner, allowing 1 in. for plank lap. Fasten the lapped edges together with 1-in. iron or copper clout nails, spaced 2 in. apart. Hold an iron on the underside while clinching. Before fastening a plank, thoroughly coat the lap with marine glue and place 1 in. wide muslin tape over the glued area. This insures a permanently water-tight joint.

THE ¾ by 1¼ in. seat riser is fastened to the frames at the height shown, with one 2-in. No. 10 F.H. screw at each joint. Slightly notch the frames for the riser. Nail a small block to the stem directly under the ends of the risers, and nail risers to block. Fasten the after and forward seat supports in place with 1¼-in. No. 8 F.H. screws. To hold the rear seat support, ¾ by 1½ in. legs are screwed to the support and chine with 1¾-in. No. 8 F.H. screws. The after edge of the transom seat is supported with a ¾ by 1½ in. piece screwed to transom. Bolt the mast block through the planking and keel with two 3½ by ¼ in. carriage bolts. Shape the seats as shown and fasten to the supports and seat riser with 1¼-in. No. 8 F.H. screws. Saw a circular hole in the forward seat for the mast directly over the mast block. The center of the mast should be 24-in. back from the top edge of the stem.

The breast hook and transom knees are now marked out on the 1¼-in. stock and sawn to shape. Cardboard patterns used as templates will eliminate much of the fitting. The breast hook should be slightly curved on top. Fasten in place with six 2-in. No. 10 F.H. screws, and use four screws to each transom knee.

The ½ by 1¼ in. gunwale is fitted and fastened to the breast hook, frames, and transom knees with 1¼-in. No. 8 F.H screws. Bevel the top edges of frames Nos. 1, 2, and 3 so the gunwale fits evenly.

The sheer molding is a piece ¾ by 1¼ in. with the edges rounded. Fasten to the sheer with 1¼-in. No. 8 F.H. screws spaced 6 in. apart.

Bolt each oarlock through the sides as indicated with two 3½ by ¼ in. carriage bolts. Fit oar sockets and fasten with 1¼-in. No. 8 F.H. screws.

For the well, saw a ¾-in. slot about 18 in. long through the keel and planking, from the after side of frame No. 2 to a point where the forward edge *(Continued on page 101)*

List of Materials

LUMBER

Planking: Sides, 2 pc. ½ by 12 in. by 14 ft. and 2 pc. ½ by 10 in. by 14 ft.; bottom, 2 pc. ⅜ by 6 in. by 8 ft., 2 pc. ⅜ by 6 in. by 10 ft., 2 pc. ⅜ by 6 in. by 12 ft., white pine, cedar, cypress, or mahogany.
Frames: 1 pc. ¾ by 6 in. by 14 ft., 1 pc. ¾ by 6 in. by 8 ft., oak, spruce, fir, or mahogany.
Transom: 1 pc. ¾ by 8 in. by 8 ft., oak or mahogany.
Floor boards: 2 pc. ¾ by 6 in. by 10 ft., fir or yellow pine. Saw in two pieces and resaw to make eight pieces.
Seats, well, and rudder: 2 pc. ¾ by 12 in. by 10 ft., white pine, cedar, cypress, mahogany, or redwood.
Centerboard: 1 pc. ½ by 12 in. by 3 ft., white pine, cedar, cypress, mahogany, or redwood.
Breast hook and transom knees: 1 pc. 1¼ by 12 in. by 3 ft., oak.
Oarlocks and mast step: 1 pc. 2 by 4 in. by 3 ft., oak, fir, or yellow pine.
Stem: 1 pc. 1¾ by 8 by 27 in., oak.
Sheer molding: 2 pc. ¾ by 1¼ in. by 14 ft., oak, fir, or yellow pine.
Seat supports (forward and after): 1 pc. ¾ by 4 in. by 6 ft., fir, yellow pine, oak, or spruce.
Centerboard posts, seat legs, and ledge: 1 pc. ¾ by 1½ in. by 8 ft.
Chines: 2 pc. ¾ by 1½ in. by 14 ft., oak, spruce, fir, or yellow pine. Use the same wood for all the following five items.
Clamps: 2 pc. ½ by 1½ in. by 14 ft.
Gunwales: 2 pc. ½ by 1¼ in. by 14 ft.
Seat risers: 2 pc. ¾ by 1¼ in. by 14 ft.
Skeg: 1 pc. ¾ by 1 in. by 12 ft.
Skeg filler piece: 1 pc. ¾ by 4 in. by 6 ft.
Keel: 1 pc. ¾ by 3 in. by 14 ft.

FASTENINGS

5 gross 1¼-in. No. 8 F.H. (flathead) brass or galvanized screws.
2 doz. 1¾-in. No. 8 F.H. brass or galvanized screws.
5 doz. 2-in. No. 10 F.H. brass or galvanized screws.
½ lb. 1¼-in. copper or iron clout nails.
½ lb. 1-in. copper or iron clout nails.
16 carriage bolts, 2 by ¼ in.
6 carriage bolts, 3½ by ¼ in.
4 large screw eyes for rudder, and 1 pc. 5/16-in. rod 15 in. long.

MISCELLANEOUS

1 pr. oars 7 ft. long.
1 set oarlocks and sockets (North River style).
¼ lb. casein glue.
1 qt. "C" quality marine glue (liquid).
½ gal. paint for outside.
½ gal. paint or varnish for inside.
Small quantity white lead.
Strips of cloth.

OUR NEW GENERAL UTILITY ROWBOAT

(Continued from page 100)

of the middle seat is over the other end of the slot. Two supports ¾ by 1½ by 16 in. are now coated with white lead or marine glue, and driven into each end of the well slot. Screw the forward post to frame No. 2 and the afterpost to the edge of the seat. Fit the ¾ by 12 in. well sides to the keel and posts. Liberally coat the bottom edges with white lead or glue, and clamp to the posts. First fasten the well boards from the bottom up, with four 2-in. No. 10 F.H. screws in each board. Fasten them to the posts with 1¼-in. No. 8 F.H. screws spaced 1½ in. apart.

Turn the hull over and plane the center seam flat so the skeg will fit evenly. Thickly smear white lead in seam. Fasten the skeg filler piece from the inside with four 2-in. No. 10 F.H. screws. The ¾ by 1 in. skeg is now fastened to the filler piece and to the center of the keel with 2-in. No. 10 F.H. screws spaced 8 in. apart. Saw the skeg off at each side of the well slot, and bevel the skeg out to ⅜ in. at the stem.

Fasten the 5/16 by 2⅝ in. floor boards to the frames as shown, separated ¾ in., with 1¼-in. No. 8 F.H. screws. Provide short center supports between frames for the floor boards.

Sand the entire hull smooth. The seats and inside are varnished or painted as desired with three coats. The sides and bottom should be painted with three coats of good lead and oil paint. Sand lightly between coats.

The mast should be made as shown, 10 ft. long, tapering from 3 to 2 in. Saw it square on the bottom to fit the mast block. The boom and gaff may be sawn from a 2 by 6 in. plank. The boom is 11 ft. long, 1¾ in. in diameter; the gaff 8 ft. long, tapering from 1¾ to 1¼ in. Use spruce, fir, or yellow pine for the spars. Saw them out square, then shape them round with plane and sandpaper.

The sail requires 10 yd. of closely woven muslin or sheeting. Sew a ¼-in. cotton rope inside the outer hemmed edge to prevent stretching. To lace the sails to the spars, insert ¼-in. grommets every 10 in. on the boom and every 12 in. on the luff. Use four ⅜-in. rope rings on the mast, and lace the remainder of the sail to the spars with ¼-in. cotton rope. Use ¼-in. or 5/16-in. rope for the halyards.

The rudder, made as shown, is attached to the hull by fastening screw eyes to the transom and rudder, through which a 16 by 5/16 in. iron rod is dropped. Shape the rudder handle from a ¾ by 2 by 30 in. piece of oak, and bolt to the rudder.

The ½-in. dagger type centerboard is merely pushed through the well. A ¾ by 2¼ by 18 in. headpiece is notched all the way through and is screwed to the centerboard.

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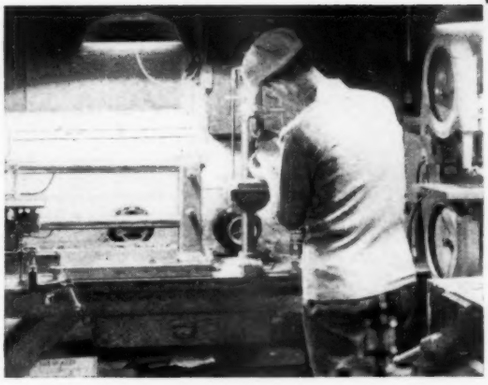

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2" Long	20c	25c
2½" Long	25c	30c
3" Long	30c	35c

Brass Davits Tapered Turned. 2"..75c pr 3"..85c pr

Propellers Right or Left

1¼" dia.	20c
1½" dia.	25c
1¾" dia.	30c
1½" dia.	35c
2" dia.	40c

Turnbuckles Turned Brass.

Take-up	A	Toggled
1/2"	25c	30c
3/4"	30c	35c
1"	30c	35c
1 1/2"	80c	85c

Funnel Ventilators

Cowl	Pipe	Price
5/16"	3/32"	5c
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5/8"	5/16"	10c
11/16"	3/8"	12c
3/4"	3/8"	15c
1"	1/2"	18c
1 1/8"	1/2"	20c

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Size	Single	Double	Triple
1/16"	3c	4c	5c
3/32"	3c	4c	5c
1/8"	3c	4c	5c
3/16"	3c	4c	5c
1/4"	4c	5c	6c
5/16"	4c	5c	6c
3/8"	4c	5c	6c
1/2"	4c	5c	6c

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1 3/8"	25c
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1"	6c
3/4"	9c
7/8"	10c

Cleats

1/4"	5c
1"	6c
1 1/8"	8c

Bitts

1/2"	6c
3/4"	8c
1 1/16"	12c
1"	10c

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Prevents rust on fishing tackle and firearms. The best lubricant for household appliances, a perfect furniture polish.

A Handy Can, 35c, postpaid if dealer cannot supply.
Wm. F. Nye Inc., Dept. S, New Bedford, Mass.

Always mention POPULAR SCIENCE MONTHLY when answering advertisements in this magazine.

NATIONAL HOME WORKSHOP CONTEST

(Continued from page 75)

of the club. He will be assisted by a committee composed of Clyde F. Cook, president of the club, Charles M. Fountain, Steve Smith, George F. Gladfelter, and Fred Jepson. The auxiliary is known as the Y. M. C. A. Division of the Topeka Homeworkshop Club. The boys have elected the following officers: Billy Dague, president; Richard Iliff, vice president; Lyman King, Jr., secretary; Eugene Erskine, treasurer, and Pete Cooper, librarian.

The first exhibition of the Topeka Club, successful beyond all expectations, was held in the Central Market. The 155 entries were viewed by 2,500 visitors. The "Topeka State Journal" gave the club a week's publicity, and for three nights a five-minute broadcast was donated by the Kapper Publishing Company over Station WIBW. The exhibition included woodwork, inlaying and overlaying, turning, archery, decorative metal work, model ship and coach building, cement work, photography, tool making, Keene's cement ware, and work done by the members of the club in the show card class conducted by Mr. Gladfelter. Dr. S. T. Millard exhibited a table containing 4,400 different pieces of wood gathered from 190 different localities.

A meeting of the club was held at Dr. Millard's shop recently so that the members could see his collection of over 2,000 wood samples from all over the world and some of his models, among them one of a steamship 4½ ft. long. This model required about a year to build, and the deck fittings alone cost over $100.

In writing to Guild headquarters about the exhibition, Mr. Cook, president of the club, said: "We followed your plans almost to the letter as to forms and methods and experienced no mishaps. We engaged one of the club members to be responsible for all entries and check them in and out."

One of the features of the exhibition was a demonstration on the wood-turning lathe given by Algot E. Anderson, an industrial arts instructor.

At another recent meeting, an illustrated talk and demonstration was given by Glen Rogers on how sound movies work.

An especially well-staged and varied exhibition was given by the Homeworkshop Club of Cleveland, Ohio. One of the accompanying photographs shows a corner of the exhibit and another illustrates several entries—a pair of garden gates by Dr. J. A. Kindler with cream panels and green trimming, a speed boat by P. C. Neale, a galleon model by T. R. Graham, a bookcase by P. B. Howard, and an intricately inlaid combination card table and checkerboard with a cribbage board insert by Norman Vacha. Dr. Kindler had several other unusual exhibits. One, shown in the larger photograph, is a miniature replica of a mill in Denmark, containing 1,109 pieces of wood. Another model by him is an old grist mill made from wood taken from old buildings. A piece of wood actually worn with age was used for the steps, and the loading platform has old wagon marks. There is even a tiny corn cob latch on the door. The model required nearly a year to build.

Other exhibits were: Solid bronze lamp, chrome plated, by L. Henninger; a U. S. lighthouse model, cast iron, equipped with flasher light and revolving lens, by John Bishop; copper lamp, desk set, and other articles by John Steinke; shelf by James Gibbons; cribbage board by B. Denly; model airplanes and an electrically driven outboard sea sled by J. Schabo; jewelry by Mr. Vacha; ash trays, cigarette holder, gavel, and model of Admiral Bird's *City of New York* by T. B. Owens.

Another unit in the Guild that has decided to build a club house with a complete shop is the Billings Homeworkshop Club of Billings, Mont. A committee has been appointed to collect data and to make the necessary plans. It is hoped to start actual work on the project in September.

Three different hand looms were demonstrated at a recent meeting of this club by Mr. and Mrs. O. C. Houchin. Mr. Houchin, who is 80 years of age, is the oldest member of his club. Mrs. Houchin, because of her keen interest in the club and her skill and experience in craftwork, has been made an honorary member.

The Saginaw Homecraft Club of Saginaw, Mich., is fortunate in having a large meeting room that will hold seventy members, and two smaller rooms, all provided through the courtesy of Morley Brothers Hardware Company. An office desk, two display cabinets, a workbench, and two filing cabinets were also donated by the company. T. J. Poitras, the advertising manager, is a member of the club.

When the question of seats came up, it was decided that each member of the club should make a chair for himself. These are small lawn chairs stained a walnut color and varnished.

As a club project, the members are making a totem pole. Each man will carve one of the teeth in the head of an animal resting on top of the pole and will place his initials on the tooth.

The club entertained ten members of the Flint Homeworkshop Club of Flint, Mich., recently. Although the Saginaw Club began with nineteen members, it now has thirty-two. Its annual meeting will be celebrated with a banquet to which the wives of the members will be invited.

The Goodyear Homecraft Club of Akron, Ohio, has been assigned a regular meeting place in Goodyear Hall by the Employees Activities Com- *(Continued on page 103)*

More Home Workshop Clubs Organized

THE following new clubs have been organized and granted charters by the National Homeworkshop Guild since the July issue of POPULAR SCIENCE MONTHLY was published:

Bison Homeworkshop Guild, Buffalo, N. Y.

Bloomington Homeworkshop Club, Bloomington, Ind.

Chicago Premier Homeworkshop Club, Chicago, Ill.

DeKalb Homeworkshop Guild, DeKalb, Ill.

Hammond Homeworkshop Guild, Hammond, Ind.

Patillas Homeworkshop Club, Patillas, P. R.

Philadelphia Homeworkshop Club, Philadelphia, Pa.

Seattle Homeworkshop Club, Seattle, Wash.

Yakima Homeworkshop Club, Yakima, Wash.

These clubs are in addition to those listed in previous issues. All new clubs will be announced in these columns as soon as possible after their organization. POPULAR SCIENCE MONTHLY *publishes all official news of Guild headquarters and the various local clubs.*

HOME WORKSHOP CONTEST

(Continued from page 102)

mittee of the Goodyear Tire and Rubber Company. The club was the first-group prize winner in a hobby fair held in connection with the Goodyear Hall anniversary celebration.

The Jacksonville Homeworkshop Club of Jacksonville, Fla., divides each meeting into two periods. At the meeting pictured in one of the accompanying photographs, for example, a talk was given on various woods and their finishes, and then H. Harvel, a manual training instructor at the Kirby-Smith Junior High School, gave a demonstration on constructing boat and airplane models.

The annual hobby show of Janesville, Wisc., was held under the joint auspices of the Janesville Homecraft Club and the Community Boys and Girls Work Departments in the gymnasium and boys' division of the Janesville Y. M. C. A.

A completely equipped workshop and lecture room has been placed at the disposal of the Scranton Craftsman Society of Scranton, Pa., through the courtesy of the Scranton Recreation Bureau. R. Carleton MacConnell, a paint and varnish expert, recently gave a talk before the club.

Keep Your Club IN THE SPOTLIGHT

BE SURE your home workshop club gets all the publicity it is entitled to. It will please the members and attract new men to your meetings.

1. Send reports of all meetings to the local papers and occasionally offer the editors good, human-interest photographs.

2. Send a set of newspaper clippings to the Guild Editor, POPULAR SCIENCE MONTHLY, 381 Fourth Avenue, New York, N. Y., to go in the Guild Scrapbook.

3. Send all important news of your club and a selection of your best photographs to the Guild Editor.

4. If there is a broadcasting station in your vicinity, try to get some time on the air to tell about the great growth of the home workshop hobby. Mention your own club and just what it offers.

WHAT THE GUILD WILL DO FOR YOU

TO FIND out what the National Homeworkshop Guild will do for you, fill out the coupon below. You will receive a free bulletin that tells in great detail how to organize a local home workshop club in your own community.

National Homeworkshop Guild
c/o Popular Science Monthly
381 Fourth Avenue, New York, N. Y.

I am interested in the home workshop club idea and wish to know what the National Homeworkshop Guild will do for me. Please send me this information in the large self-addressed and stamped envelope I am inclosing.

Name .....

Address .....

City..... State.....

(Please print very clearly)

I'D GIVE MY LAST CENT TO GAIN WEIGHT AND HAVE A REAL FIGURE
YOU DON'T HAVE TO BE SKINNY. I'LL TELL YOU HOW TO GAIN 10 LBS. IN A FEW WEEKS

New discovery! Fills out skinny figures

so quick you're amazed

Astonishing gains in a few weeks with sensational new double tonic. Imported brewers' ale yeast, richest yeast known, now concentrated seven times and combined with energizing iron. Adds 5 to 15 lbs.—quick!

WHAT would *you* yourself give to put on pounds of firm, attractive flesh in a few short weeks? Thousands have already done it—*inexpensively*—with this new discovery.

As you know, doctors for years prescribed yeast to build up health for run-down men and women. But now this new discovery gives you far greater tonic results than ordinary yeast—rebuilds health and also puts on pounds of solid flesh—*and in a much shorter time.* And brings other benefits, too. Blemished skin changes to a fresh, glowing, radiantly clear complexion. Constipation, poor appetite, indigestion, lack of pep vanish. Life becomes a thrilling adventure.

Concentrated 7 times

This amazing new product, Ironized Yeast, is in pleasant tablet form. It is made from special *brewers' ale yeast* imported from Europe—the richest yeast known—which by a new process is concentrated 7 times—*made 7 times more powerful.*

But that is not all! This marvelous, health-building yeast concentrate is then *ironized*—scientifically combined with three special kinds of iron which strengthen and enrich the blood—add abounding new energy and pep.

Day after day, as you take Ironized Yeast, you'll see ugly angles fill out, hollow chest develop, arms and legs round out pleasingly. Complexion becomes lovely, indigestion disappears—new vitality comes.

Danger in skinny body

Authorities warn that skinny, anemic, nervous people are far more liable to serious infections and fatal wasting diseases. So begin at once to get back the rich blood and healthy flesh you need. *Do it before it is too late.*

Results guaranteed

No matter how skinny and weak you may be, this marvelous new Ironized Yeast should build you up in a few short weeks as it has thousands of others. If you are not delighted with the results of the very first package, your money instantly refunded.

Only be sure you get *genuine* Ironized Yeast and not some imitation that cannot give the same results. Insist on the *genuine*, with "IY" stamped on each tablet.

8 Lbs. in 3 Weeks
"In one week I gained 4 lbs., in 3 weeks 8 lbs. with Ironized Yeast. Tired feeling and constipation are gone, too." *Roy H. Tinney, Oklahoma City, Okla.*

11 Lbs. in 3 Weeks
"After taking Ironized Yeast for 3 weeks I gained 11 lbs. and new pep." *Mrs. H. J. Froreich, National City, Calif.*

15 Lbs. in Month
"I gained 15 lbs. in a month with Ironized Yeast." *Louise Adams, Friars Point, Miss.*

Special FREE offer!

To start you building up your health *right away*, we make this absolutely FREE offer. Purchase a package of Ironized Yeast at once, cut out the seal on the box and mail it to us with a clipping of this paragraph. We will send you a fascinating new book on health, "New Facts About Your Body", by a well-known authority. Remember, results are guaranteed with the very first package—*or money refunded.* At all druggists. Ironized Yeast Co., Dept. 458, Atlanta, Ga.

"I'M YOUR BEST FRIEND. BE MINE—SEND FOR IT NOW!"

GLOVER'S NEW
DOG BOOK
FREE

It's the most complete, interesting and instructive book in colors on the Care of your Dog ever produced. Contains a wealth of valuable, authoritative information. Send for your copy today.

H. CLAY GLOVER CO., Inc., Dept. S, 119 Fifth Ave., N. Y.

New 9" x 3' South Bend Lathe

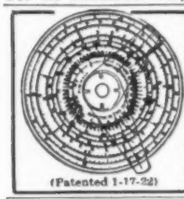
This new 9¼" swing by 3' bed "WORKSHOP" LATHE is a Back-Geared Screw Cutting Metal Working Lathe; takes 18" between centers. Can also be used for working wood, compositions, etc. Has automatic longitudinal feed, graduated compound rest, ¾" hollow spindle. Operates from lamp socket for 2 cents per hour. Cuts screw threads 4 to 40 per inch. Price with reversing motor, reversing switch and belting, $94. Write for descriptive Circular No. 5-W. Sent postpaid.

$75 less motor drive

Easy Terms $7.00 per Month

Wt. 300 Lbs.

SOUTH BEND LATHE WORKS NRA
849 E. Madison St., South Bend, Ind.



The Midget Slide Rule

equals a 12 in. straight slide rule in precision. Has A, B, C, D, CI, Log-Log, Binary, Add and Subtract scales. Gives Logs., Gives Trig. functions to 1 minute from 0 to 90 degrees. The Engine-divided scales are on white coated aluminum. Permanently accurate. The Midget is, undoubtedly, the most versatile calculator ever invented. Dia. 4 in. Price, with Fabrikoid case and Instruction Book $2.00, cash or C. O. D. Money back if not satisfactory. Circulars free.

(Patented 1-17-22)

Gilson Slide Rule Co., Stuart, Fla.
Slide Rule Makers since 1915

AUTOMOBILE COMPASS

Have you ever taken the wrong road and traveled many miles before discovering your mistake? This new AIRPLANE TYPE COMPASS constantly tells your direction of travel. Sticks to windshield. Base 1½" diameter. Only $1.50, POSTPAID. SATISFACTION GUARANTEED or your money refunded if returned within ten days.

AGENTS WANTED!

HULL MFG. CO., Box 246-E8, WARREN, OHIO

VENEERING IS EASY

HJORTH'S complete book "How to Make Veneered Panels for Home and School Workshop" shows every step in cutting, matching, gluing, pressing, finishing veneered panels of every type. Actual projects detailed with scale plans. Clothbound; 96 Pages, 70 Illustrations; $1.00 postpaid. Send check or money order.

The Casein Manufacturing Company of America, Inc.
350 Madison Avenue New York, N. Y.

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AUTOMOBILE RACING

All new material. Tells How. Get dope on 100 m.p.h. stock Fords, 110 m.p.h. Midgets, 120 m.p.h. Ford A and B Conversions, 125 m.p.h. modified stock and 135 m.p.h. stock conversion Speedway Racer. Working drawings, pictures and full description. Race Car Records. Order NOW. Postpaid $1.00, C.O.D. $1.12. Ray Kuns, Dept. D, Madisonville, Cincinnati, Ohio.

SHIP MODEL FITTINGS

Build the 4-mast Barque, California

Accurate, detailed blue prints of this handsome, steel barque. Complete fittings and construction sets for steam trawler and other popular models including the "Hartford". Send 15c (coin) for new illustrated catalog. See our display in The Homeworkshop General Exhibits Bldg.—Century of Progress—Chicago.

A. J. FISHER
1002-2 Etowah Ave. Royal Oak, Mich.

INVISIBLE TARGET HIT BY NAVY'S MIRACLE GUNS

(Continued from page 52)

head, no matter at what altitude. How these guns operate and achieve phenomenal altitudes is one of the most closely guarded secrets. They can fire almost vertically, though for safety of their own crews against falling shell fragments, they seldom are pointed higher than sixty degrees from horizontal.

NIGHT no longer offers a problem. As far as the guns can hurl their destructive projectiles, they can throw into the air over a target star shells—large flares that illuminate the ocean with the brilliance of a billion candles as they float gently down underneath parachutes of silk. Like ghosts on a phosphorescent sea, targets are revealed long enough for observers to note their position or, should they be aloft, for aviators to spot the splashes of falling shells and radio back to the ships corrections for the next salvo of steel.

At shorter ranges, searchlights, high above the water, cast their brilliant beams eight miles to reveal enemy ships and hold them at the mercy of both large and small guns.

Smokeless powder, containing a small quantity of black powder to spread the fire rapidly, propels the heavy projectiles. Unlike the small particles used in rifle and revolver ammunition, these powder grains measure one and one-half inches long and are a half-inch thick. Each grain is filled with a multitude of tiny holes, so it will burn inside and outside simultaneously.

Gunnery officers test samples of the powder supply frequently to make sure it is not deteriorating, is ready for instant action. All of the powder is overhauled when five years old and thereafter every three years. Though it is kept dry in a constant temperature of seventy degrees, some of the powder may go bad. When overhauled, it must test non-acid, give off the proper odors when heated, and taste right, or out it goes to make room for a fresh, dependable supply.

Extreme care is taken to keep all compartments tight when handling the powder, to prevent the spread of fire in case of an explosion. The act of opening the breech after firing, automatically turns a jet of cold air under high pressure into the gun. This blows out unburned bits of powder and cloth and cools the inside of the weapon. Often after the gun has gone off, the air blows gaseous flames out the muzzle. Should these flare back into the turret, lives would be lost.

Several years ago forty-eight men were killed almost instantly on the Mississippi when a glowing cloth fragment which had not been expelled ignited a 100-pound bag of powder as a rammer thrust it into the breech. So intense was the heat it fused the rubber on the turret doors, making it impossible for rescuers to enter.

WHEN finally acetylene torches had cut through the tough steel armor, the ship was riding at anchor in Los Angeles harbor. Rescuers found a dead gun pointer sitting at his post. As they carefully started to move the body, his fingers jerked the trigger and the fourteen-inch gun roared out its final shot.

The fourteen-and sixteen-inch guns measure more than fifty feet long and, when new, can propel their heavy projectiles with deadly accuracy nearly twenty miles. At maximum range, they are set at an angle of thirty degrees. During many practices, for purposes of economy, sub-caliber guns, fixed to the turrets immediately beneath their giant companions, are used merely to make a noise and indicate the crew actually has fired. The powder charge for the little fellows costs ten cents, as against some $400 for a fine steel armor piercer and the 400 pounds of powder required to fire a big gun.

For a very good reason, much of the practice is confined to loading, pointing, training—the preparations for shooting. The life of a sixteen-inch gun is 200 rounds. After that its effectiveness in both range and accuracy is lost. Often the crews go through all the motions of firing, including loading dummy projectiles and powder bags. These are the same size and weight as service ammunition. To eject the shells, brass slugs weighing 500 pounds are pulled up to the muzzle, the guns elevated and the slugs allowed to slide back down the barrels to force the projectiles out onto the loading trays.

THE sixteen-inch guns move and train together, but may be pointed and fired separately. They also recoil in separate slides. Some fourteen-inch guns move and fire in battery, or as a single unit. Though the terrific explosion of the powder exerts a force of sixteen tons to the square inch, the powerful recoil mechanism takes up the shock as the guns travel back on their tracks no more than forty-two inches.

Some freakish shots are observed occasionally as the big shells lumber through the air. They may be seen easily by persons stationed aboard ship, and when fired at shorter ranges with reduced muzzle velocities, aviators high in the air can trace their course easily from the time they leave the guns, climb high into the sky, and fall on the target.

When the three guns of a fourteen-inch turret are fired, the projectiles, which measure four feet in length, are less than four feet apart as they leave the muzzles. Theoretically they should fly through the air at the same speed and land together. Sometimes one lags behind in the turbulent eddies set up by the leading shells and is forced off its course. Occasionally officers observe one crossing over from one side to the other. Two shells have been known to kiss while in the air and fly away in different directions.

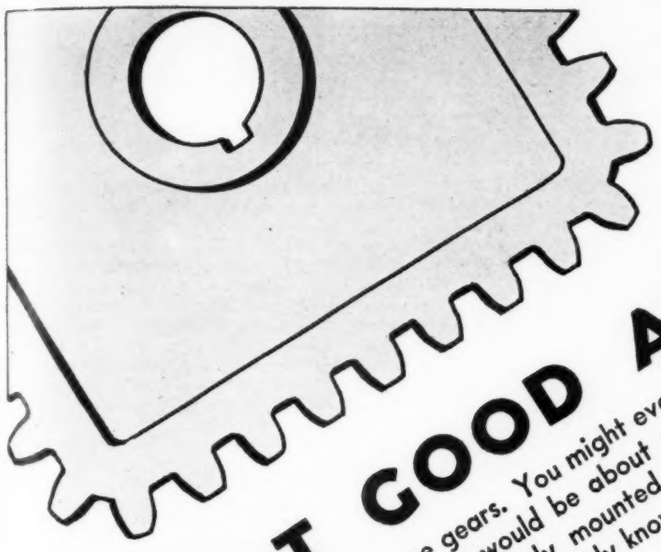
THESE are, of course, freaks for which no one can account and science has, as yet, found no way to overcome them. Yet, odd as it may sound, here are the results of one shot, the chances for a recurrence of which are so remote as to be virtually impossible:

Following a recent short-range battle practice off Los Angeles a repair party left ship in small boats to fix up the targets, which consist of a series of cloth uprights measuring fifteen by twenty-five feet and erected on long rafts. When they reached the raft, they found sitting upright on the base of the target a fourteen-inch cast iron non-explosive practice shell. It had struck the water and, instead of bouncing through the target, had only enough momentum left to reach the raft before sitting down at rest on the target.

WORLD WAR SHELLS LAY BARE ANCIENT SECRETS

GUNNERS bombarding the eastern front during the World War had no idea that they were bringing to light treasures of archaeology. In the shell holes in Jugoslavia, members of an expedition sent out by Harvard University have found treasures which go back to the Bronze Age in Central Europe. Nearly 2,000 sites have been marked out, as a result of the studies made by the expedition. Here future digging will take place. By making a 3,500-mile survey of the territory, the scientists have uncovered Roman roads and fortifications which heretofore were heard of only in legends. In one spot, they found a strategic site where armies since 2000 B.C. had been making encampments.

This seal on an advertisement signifies the approval of POPULAR SCIENCE INSTITUTE OF STANDARDS.



WHAT GOOD ARE SQUARE GEARS ?

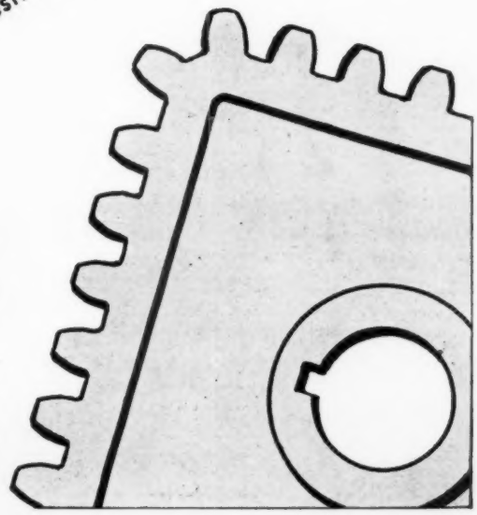
Possibly you never heard of square gears. You might even laugh at the idea and say that square gears would be about as useless as square automobile wheels. Yet, properly mounted and meshed, square gears not only work but supply the only known way of causing certain machines to operate as required.

50,000 A WEEK SEE SQUARE GEARS WORK

You can see square gears working and moving twelve hours every day at The Mechanical Wonderland, Popular Science Monthly's exhibit at the great Chicago World's Fair. These gears are only one of 160 moving, working models that form the most vivid, understandable, and instructive demonstration of the principles of mechanics ever made. From the moment it was put in operation Popular Science Monthly's exhibit has been one of the most popular spots in the whole Exposition. An automatic counting machine recorded more than 50,000 visitors to the Popular Science Monthly booth in a single week last Summer.

"AN EDUCATION IN ENGINEERING"

"Your exhibit is an education in engineering for the public," wrote an early visitor to the Fair. This man did not exaggerate. Every mechanical movement and principle employed in present-day machinery, from simple levers to the radial internal combustion engine used in aircraft, can be found in this unique collection of working models. Mr. W. M. Clark, originator and builder of the exhibit, and a group of assistants are in constant attendance at the booth to answer questions or perform any other similar service.



. . Visit Popular Science Monthly at the WORLD'S FAIR

We are happy to repeat our invitation to visit our World's Fair Exhibit. The Mechanical Wonderland, which we present with the courteous cooperation of the Newark (N.J.) Museum, is situated in the Pavilion of Industrial Engineering, second floor, General Exhibits Building One, adjacent to the Hall of Science.

WHY LIFE INSURANCE Bought Direct COSTS SO LITTLE!

You have no agents' commissions or branch office expenses to pay. You deal direct-by-mail with the Company and SAVE! It is significant that in the depression years of 1933 and 1932 Postal Life of New York sold more life insurance than in any other two years of its history. In 1933 its business increased 45% and in 1932, 43%.

Postal offers a guaranteed saving of 9½ per cent per year on every premium (including the first) as well as a contingent (or second) dividend as earned and declared. No other insurance company we know of guarantees dividends.

Postal is a 29-year old safe company that has paid over $40,000,000 to policy-holders and beneficiaries. It is under the strict supervision of the New York State Insurance Department and is subject to the U. S. Postal Authorities.

Find out what you save on sound Legal Reserve Life Insurance. Just send the coupon indicating the type of insurance. Or fill in the consultation blank as well and we will recommend the kind best suited to your needs. No obligation.

FREE INFORMATION—MAIL TODAY

Postal Life Insurance Co., Dept. 647
511 Fifth Ave., New York.

Send free information on: ☐ Ordinary Whole Life; ☐ Special $5000 Whole Life; ☐ Limited Pay. Life; ☐ Endowment; ☐ Term; ☐ Annuities.

Amount of insurance desired.....
Exact date, year of birth.....
Occupation.....

If you want our recommendation, please answer these questions:

Amount of life insurance now in force.....
Total amount premiums paid each year.....
Ages of dependents.....
Annual Income..... *Approximate Debts*.....

Name.....
Street and Number.....
City..... *State*.....

HAENEL "100 SHOT" REPEATER

$4.95

Latest Model 1934 Haenel repeating pistol. Sturdy, massive construction, easy cocking lever, 100 shot magazine. For target. Powerful for small game. Blue or Nickel finish, shoots B.B. steel shot. Weight 18 oz. **FREE**—500 Shots, $2.00 deposit on C. O. D. *FREE Catalog—Colts, Rifles, Binoculars, etc.*
Hudson Sporting Goods, P-52 Warren St., New York

ARE YOU A PUZZLE FAN?

Nonplus your friends with the new and baffling NUT SLAT! Not a practical joke—but a challenge for the gray cells! Stops them all: professors, scientists, business men—yet as simple as 1, 2, 3. Entertainment in a field by itself! Marvelous for fishing trips, smokers, bridge parties and picnics. Not yet available at novelty shops—Be a pioneer!

Each NUT SLAT 10c, Solution FREE!
Address: SHERMAN PUZZLETIES
403 Allen Ave., Chillicothe, Ohio
Attention: Psychological Clinics & Novelty Shops
Special prices in quantity!

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YOU WILL BE AMAZED BY OUR LOW PRICES!
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121-D West 17th St., New York

FORMS TO CAST LEAD SOLDIERS, INDIANS, TRAPPERS. Hunters, wild and Farm Animals. 222 Wonderful "True to Life" models. Easy and inexpensive to make. I furnish all necessary material. Send 5c Stamp for Illustrated Catalogue.

Henry C. Schiercke, Ghent, New York

BIG MONEY Assembling NEW BOAT IN 3 DAYS

Make *big money* on each 20 lb. Mead Ki-Yak you *easily assemble* at home in 3 days from *complete* "cut-to-fit" Kit, $15.75 F.O.B. Factory (2-Seater, $19.50). Can't sink. Seaworthy. Fast! Snappiest thing afloat. Complete Sailing Rig, a few dollars extra). **Rush** 10c for illustrated folder and **Free** $6 Paddle Offer!

GIVEN! $6 Double-blade Paddle now given with your Ki-Yak—*if you hurry!*

MEAD GLIDERS, Dept. D-8 **12 S. Market, CHICAGO, ILL.**

HUNTING FIREBALLS THAT FALL TO EARTH FROM OUTER SPACE

(Continued from page 33)

and the terrific impact would shake half the continent of North America.

The greatest meteorite known to fall in recent times collided with the earth in North-Central Siberia on June 30, 1908, mowing flat more than seven hundred square miles of forest, and shaking the earth so violently that a train, 200 miles away, was forced to stop to keep the rails. Yet it was only a pebble in size as compared with the mythical projectile described by the Tilford grocer.

THERE are scars on the earth, however, which show that far greater meteorites have fallen in prehistoric times. The best known is the Meteor Crater near Winslow, Ariz., where an enormous mass of iron, millions of tons in weight, once bored its way more than 1,300 feet into the sand and rock of the desert. Other big craters or groups of craters have been found in Argentina, in Central Australia, in Afghanistan, and on the Isle of Essel in the Baltic. Infinitely greater than all of them put together, however, was the meteoric fragments that made the Carolina bays. There, long before the dawn of history, a great swarm of meteorites is believed to have plunged to earth, leaving scars that still may be seen over an area of 40,000 square miles along our Atlantic seaboard.

The conclusions of the Tilford grocer were based, of course, on his lack of familiarity with the science of meteoritics. His report, however, was not without value, for he gave the angle above the horizon at which the fireballs had appeared to him. That was real information. Long ago Nininger learned that every account must be carefully analyzed and the dependable information winnowed out of it.

Some observers will declare that a fireball traveled from east to west, when it actually went from west to east. Occasionally, too, one will state that it soared straight up from the horizon, or that it descended straight down from the zenith. If you ever see a meteor which seems to go straight up, or straight down, you may be pretty sure that you were almost directly under its path. If you happen to face in the direction from which it comes, it will seem to go straight up; if you face in the other direction, it will seem to go straight down.

In spite of the contrary reports that always come to him, however, Nininger seldom finds it difficult to get fairly accurate information on the direction taken by a meteor, for the majority of observers are always pretty much in agreement on that point. So were they in the case of the Wyoming-Nebraska fireballs. The next step was to spot the location of each observer on a map. These spots were then divided into two groups, one group marking the locations of all persons who saw the meteor to the south of them, and the other of those who saw it to the north. Obviously, a line drawn between the two groups indicated, roughly, the path taken by the meteor. The accuracy with which any meteoric course may be plotted depends on the number of observers, and especially on reliable reports from persons who saw the fireball slightly to one side of the zenith. Such observers are naturally more nearly right under its path.

NOW, with the course of the meteor plotted, a much more difficult problem arose. The angle of its descent had to be determined. If it came down sharply, the masses which reached the ground should, of course, be sought not far from under the point in the sky where the fireballs faded from sight. On the other hand, if they followed a path more nearly parallel to the earth's surface, the missiles may have traveled many miles before they hit the earth.

The only way to get at the angle of descent is to determine the altitude of a fireball when it first appears, and its altitude when it disappears. This must be done by triangulation, based on reports from the most dependable observers at both ends of the course. In other words, if two observers, a known number of miles apart, happen to see a meteor at the same instant and are able to report pretty accurately its angular distance above the horizon, then a simple trigonometrical computation will reveal the altitude of the fireball.

IT IS difficult, however, to get reports sufficiently accurate to use in computations with any degree of assurance. Too few observers are able to say what they actually saw, or where they saw it. If you wish to prepare yourself to help scientific investigators with really useful information, in case you are lucky enough to see a large meteor, you should first acquaint yourself with the names of the more important constellations and the larger stars overhead at each season of the year.

Then, when you see a fireball, you can report that it appeared in such and such a constellation, or near such and such a star; that it traveled through other constellations, named in your report, and that it disappeared at a given point. That kind of a report would be extremely valuable. If you do not know the names of the stars, however, you can still give a very helpful report. Nail a stick to a tree, or to the side of a shed, pointing it at the spot in the sky where you first saw the phenomenon; and another stick pointing to the spot where you lost sight of it.

The Wyoming-Nebraska fireballs had obviously descended at a very flat angle. Further investigation revealed that they had appeared at an altitude of about seventy to eighty miles, and that they had disappeared just north of the town of Columbus, Nebr., while still about fifteen miles up.

A meteorite fragment can always be distinguished just by its appearance. There are two common varieties, iron and stone. The iron type is easy to identify. It is heavy, and if newly fallen, it is black outside.

A stony meteorite is harder to recognize. It, too, will be heavier than the average stone, and will almost always be covered with a black or reddish-brown crust. Also it will often have pits in it, but the pits will seldom be as sharply defined as in the iron variety.

There are two kinds of stony meteorites. One, when newly fallen, looks much like a chunk of grayish-white cement, covered with a crust of black paint. The other is darker inside, sometimes quite black.

THE black crust, which covers all stony meteorites when they first come to earth, turns gradually to reddish-brown, and often the surface gets to look much like the crust of a loaf of whole-wheat bread, with similar little pimples, or flakes, scattered over it.

There are various ways in which you, the layman, can advance the science of meteoritics if you work intelligently. First, be constantly on the lookout for meteorites. If you find a strange stone, or mass of iron, which you think is part of a meteorite, send a small sample of it to some scientist. Tell him where you found it and under what circumstances. If you see a large meteor in flight, locate exactly in the sky the point at which it appeared and the point at which it disappeared. Get the exact hour and minute of its appearance. Judge its size. Listen for any noise that it may make. See whether it leaves a trail of misty light behind it. Note how long the trail lingers after the meteor vanishes. Above all, if you should ever get a chance to photograph a fireball, do so. Only one such photograph has ever yet been taken.

ACE RODEO RIDER TELLS HOW HE TAMES BRONCOS

(Continued from page 26)

the heeler comes in, catching both hind legs in his loop, and quickly pulling the steer down. All that remains is for the head man to tie the pigging string around the brute's hind legs with a square knot and below the hocks.

Bulldogging requires a lot of skill as well as brute strength. In recent years California has forbidden bulldogging, substituting "decorating" which means slipping an elastic band over the steer's wet nose while running nearly thirty miles an hour.

IN BULLDOGGING, the steer comes out of a chute between the hazer and the dogger. When the dogger reaches the bull's flanks, with the hazer riding in close on the opposite side to prevent the bull turning away, he goes down, leaving the saddle headfirst. He grabs the horns with both hands, digs in his heels and sits down, pulling the animal's head sharply around. Then he straddles the left horn, passes both arms behind the right horn and grabs the bull by the nose, twisting the nose upward and walking backward. This takes the animal off balance and pulls his horns over and down on the ground, with the nose pointing straight toward the sky. A good man can throw a bull in seven seconds after leaving the chute.

In "decorating" I start leaving my horse when abreast of the animal's rear quarters. I hug him around the neck while still in the air, passing my right hand down the side, the left hand down his face. As soon as my feet hit the ground I snap the rubber band over his nose.

All the cowboys are, of course, good riders. They have good wind, are well-knit, and strong. Many of them once were boxers who developed strong arms while punching sand bags and opponents' faces. Most of us train intensively a few weeks before the season opens in February and the work keeps us in shape until it closes the following December. We need plenty of reserve strength if we expect to rope a calf, milk a wild cow, ride a wild bronco without a bridle, ride a ranting Brahma steer without saddle, ride a wild horse with neither saddle nor bridle and, for good measure, decorate or bulldog a steer—all in one afternoon.

TRACE OLD MIGRATIONS THROUGH WOODEN TOOLS

BY STUDYING 2,500 specimens of wood from the South Seas, Yale University scientists are attempting to trace the origin of Polynesian tribes. Old wooden implements and weapons, used by the various tribes, are being compared with bits of wood coming from different parts of the islands of the south Pacific as a means of tracing migrations. The wood collection was recently presented to the School of Forestry by a museum in Honolulu, Hawaii. Yale University, in cooperation with the International Association of Wood Anatomists, is sponsoring the systematic study and classification of woods throughout the world.

NEW PROCESS MAKES COPPER LOOK OLD

THE appearance of age can now be given within a few hours to copper roofs and other sheet copper work. With a method just developed, the metal is sprayed five or six times with a solution consisting chiefly of ammonium sulphate. The next rain, if it does not occur so soon that it washes off the solution before it has had time to act, brings out the blue-green coating of patina which gives copper its weathered look.

HERE'S THE ANSWER

(Continued from page 64)

the southwest, I've always been interested in snake stories. However, as much as I've read about them, I've never been able to find the answers to two puzzling questions. Is it true that a mother snake in the presence of danger swallows her young to protect them? Also, since a snake has no eyelids, how does he close his eyes to go to sleep?—R. K. L., San Antonio, Tex.

A.—Going the owl one better, the snake sleeps with both eyes open. It's been said that a sleeping snake will be awakened by seeing a noiseless movement in front of its eyes. As to mother snakes swallowing their young, experts have found nothing to prove it. Snake families, often numbering from sixty to seventy, would make quite a mouthful.

Plant Pills Not Ready

Q. SOME TIME ago you published an article entitled "Plant Pills Grow Bumper Crops." Has this fertilizer preparation been placed on the market and if so, where can it be obtained.—Dr. R. D. B., Woodstock, Ill.

A.—The plant pills described in the article you mention are not available commercially. However, you can easily prepare a similar plant solution which has some of the reported qualities of the pills. Simply add to one gallon of water a bean-sized lump of calcium nitrate. Then add potassium nitrate, magnesium sulphate, potassium phosphate, and ferric chloride, making each quantity equal to the size of a split pea. Stir the water to dissolve the chemicals and your solution is ready for use on even the most delicate plants. Apply it once or twice a week with a watering can. The solution should not be made any stronger than suggested as it will destroy the finger roots and kill the plants.

Caulking Compound

J. K., BURLINGTON, VT. A satisfactory compound for caulking the cracks that form around the outside edges of windows and doors can be made as follows: Mix 6 oz. of paste white lead, 9 oz. of dry asbestos, ½ oz. of whiting, 1 gill of linseed oil, and enough lampblack to tint the mixture to the desired color. This will make about 1 lb. of the caulking compound.

Making Colored Glass

D. P. J., ANN ARBOR, MICH. Glass is colored by including certain chemicals in the manufacturing process. For example, cobalt oxide colors glass blue; chromium oxide tints it green; manganese dioxide, violet; cuprous oxide, red; and silver oxide, amber.

Mosquito Bites

F. G. W., LEHIGH, PA. As far as we know, there is no quick cure for itching mosquito bites, but a good method of relief consists in rubbing the bites gently with toilet soap. As to a mosquito repellant that does not have the odor of citronella, you might try the following: Mix 1 oz. of pennyroyal oil, 1 dr. of anise oil, 3 dr. of spirits of camphor, and 8 oz. of ordinary rubbing alcohol.

THESE questions from readers have been selected from the thousands answered by our Information Department. Due to the large number received each month, letters requesting information will be answered only when a stamped envelope is enclosed.

101

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USING YOUR MICROSCOPE TO DESIGN ORIGINAL PATTERNS

(Continued from page 41)

a butterfly or moth tongue, when curled, will take a form closely following the spiral of growth.

Would you like to see the work of a microscopic master potter? Then collect and examine some of the slime molds or Mycetozoa. There are about 500 species of these molds known, so that you ought have no difficulty in finding them. They thrive in damp places, and their slimy masses can be found creeping over decaying leaves or rotting wood. Sometimes one of the molds will be found growing on the outside of a flower pot. Generally, they are no more than a quarter of an inch in height.

IT IS the spore cases of these molds that, under the microscope, often are objects of great beauty. You will think that you are looking at delicate porcelain trinkets when you view some of them. Others will remind you of carved ebony. The makers of vases might well look to the slime molds for inspiration.

It would be impossible to say much about the use of the microscope to discover designs without mentioning the diatoms. These tiny algæ plants are among the most beautiful objects in nature. Also they afford an almost endless variety of patterns. Artists and designers have made extensive use of diatom patterns in all types of decorative work. The collection and preparation of diatoms were described in earlier articles of this series. (P. S. M., Aug. '33, p. 34)

When winter comes, you will find it worth while to study snow crystals and frost patterns, whether or not you are particularly interested in design. You are certain to find something new at each peep, for no two snowflakes ever have been found exactly alike. Like the diatoms, snow crystals have contributed much to the wealth of design patterns that artists have been employing for years.

Here is a little game you can play while looking for hidden beauties:

The wings of insects are marked with veins, or nervures, that branch and cross. By examining the wings of various insects, you will find a wide variety of patterns. With a little stretching of the imagination, sometimes hardly any, you can pick out letters and letter combinations or monograms formed by the nervures. Try to find your own initials. If you succeed, you will experience an unusual "microscopic" thrill.

IT MIGHT well be said that, to the microscope, nothing is ugly and almost everything is beautiful. To illustrate this, various specimens of animal tissue can be photographed and subsequently arranged to produce a decorative effect. As an example, a cross section of a human spinal cord (infant) has been photographed and arranged in a design that suggests a flower! Only one familiar with such things as spinal cords could discover the real source of such a design.

Unless you are an exceptional microscopist, you have encountered considerable disappointment and suffered no little exasperation when you tried to examine and photograph objects that could not be illuminated from below. For instance, when searching a pinch of ocean sand for foraminifer, good lighting is essential. Sometimes simply placing the microscope near a window will suffice, but when observations are made at night, the window method is useless.

Therefore it is almost certain that the simple gadget illustrated will add new beauty and territory to your microscopic world. It is not difficult to make. For convenience, it will be called a top-stage illuminator. It employs, as a light source, a six-volt Mazda No. 40 radio dial-light lamp, operating from a door-bell-ringing transformer or other suitable six-volt supply.

Procure, in addition to the bulb and transformer, a silvered flashlight reflector about fifty millimeters (two inches), in diameter; two pieces of sheet brass measuring about fifteen by twenty-two millimeters, and another piece of the same material measuring about twenty by thirty millimeters; a length of flexible cord, and a brass socket shell.

INCIDENTALLY, you may wonder why the dimensions are given in millimeters. If you expect to do much work with a microscope, and particularly if you look forward to getting a highpowered laboratory instrument some day, you will have to become familiar with the metric system of measurement because that is the system employed universally by microscopists and microscope makers. You can procure, for a few cents, a scale that has both inches and millimeters engraved on it. One inch equals twenty-five and four-tenths millimeters or two and fifty-four one-hundredths centimeters. After using the metric system of measurement for a time, you will find it convenient.

To get back to the top-stage illuminator: You may have a little difficulty in procuring a socket that will hold the miniature lamp. Generally, these can be picked up at radio stores for a dime or so, or perhaps you can use the one that was fitted to the flash light from which you got the reflector. The socket illustrated consists of nothing more than a threaded brass shell, with a small bolt passing through a hole in the end and insulated from the shell with fiber washers.

The reflector has a hole in the center. Enlarge this until it is about eighteen millimeters in diameter, or large enough to let the objective of your microscope pass through without scraping. At a point halfway between the edge of the center hole and the outside edge or rim, cut a hole just large enough to permit the glass part of the lamp bulb to pass through. Bend the twenty by thirty millimeter piece of brass into a tube twenty millimeters long, and of a diameter to receive the bulb and socket in a snug, sliding fit. The tube will be open along one side, the width of the opening being about seven millimeters. Solder one end of the tube over the smaller hole in the reflector, open side towards the rim. With this arrangement, the bulb and socket can be moved in or out, until the best illumination is produced. Solder one of the flexible wires to the shell of the socket, and the other to the center contact bolt. The open side of the tubular lamp holder eliminates binding at the point where the wire is attached to the socket shell.

THE illuminator is held in position on the microscope stage by pressure of the spring slide clips against two ears that are soldered to the rim of the reflector. These ears are the two fifteen by twenty-two millimeter pieces of brass. Cut one of the wider edges of each so that it curves inward, and thus fits snugly about the reflector.

To use the illuminator, simply place the object to be examined, if not mounted, on a piece of paper, a neutral-colored blotter being excellent, and drop the reflector, open side down, over it. After centering object and illuminator in relation to the objective, adjust the slide clips so that they press firmly down on the ears of the reflector. Adjust the bulb by sliding it in or out. The object will be lighted brilliantly by direct rays from the lamp, and less brilliantly on the shadow side by light reflected from the silvered surface.

This arrangement *(Continued on page 109)*

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USING YOUR MICROSCOPE TO DESIGN PATTERNS

(Continued from page 108)

provides excellent illumination for examining nearly every kind of opaque object, such as surfaces of paper and cloth, small insects and insect parts, tiny machine parts, and almost everything else that cannot be mounted on a slide and inspected by transmitted light.

If you find that the doorbell transformer produces more than six volts and thus shortens the life of the lamp, you can connect into the circuit a piece of resistance wire, determining by experiment just how much.

Top-stage illuminators are useful only so long as the nose of the microscope objective does not cast a shadow on the subject.

An excellent way to get the jitters is to try to arrange something with a dissecting needle or tweezers while watching it through the microscope, as when separating foraminifer from ordinary grains of sea sand. When you want to push a grain of sand to what seems to be the right, you have to move the needle actually to the left, because the microscope reverses the image.

Usually you can triumph eventually, and perhaps become expert after long practice; but there is an easier way: Arrange a bright source of light so that the rays will be projected through the microscope, with little or no stray light thrown upwards. Then, a few inches above the eyepiece of the microscope, place a sheet of thin, white paper. You can lay it on a piece of glass supported by two empty store boxes. With the room darkened, focus the microscope until you see a sharp image of the object on the paper. Now you can use the dissecting needle or tweezers in the natural way, because the image on the paper is right side to.

FIRE AND AIR TESTS IN YOUR OWN LABORATORY

(Continued from page 63)

slow to be sure, but it nevertheless will take place. This slow process of combustion is referred to as slow oxidation.

You will not need any great amount of equipment to demonstrate the slow oxidation or rusting of iron. Simply fit four large test tubes with corks and in each place a few bright new iron nails.

In the first tube also place some water from which all the dissolved air has been removed. This can be done easily by boiling the water for several minutes, pouring it into the tube to completely cover the nails, and then dropping in a small quantity of oil to form a seal and prevent any air from redissolving. The nails then will be exposed to water but not to air or free oxygen.

In the second tube place enough unboiled tap water to cover the nails. Since some air is bound to be dissolved in the water these nails will be exposed to air as well as moisture.

To the nails in the third tube add only several drops of water.

Finally in the fourth tube place a small vial of strong acid, quicklime, or calcium chloride.

You will now have four specimens of iron placed under four conditions. See that they are tightly corked and allow them to stand for about twelve hours.

When you finally inspect them, you will find that the nails exposed to air as well as moisture will be coated with a thin film of rust (tubes two and three). On the other hand, the nails in the first and last tubes, one of which lacks air and the other moisture, will be as bright and clean as ever. The fact that the iron rusted only when both air and moisture were present demonstrates conclusively that both substances must be present to support the slow oxidation of iron. When either substance is absent, iron will fail to rust.

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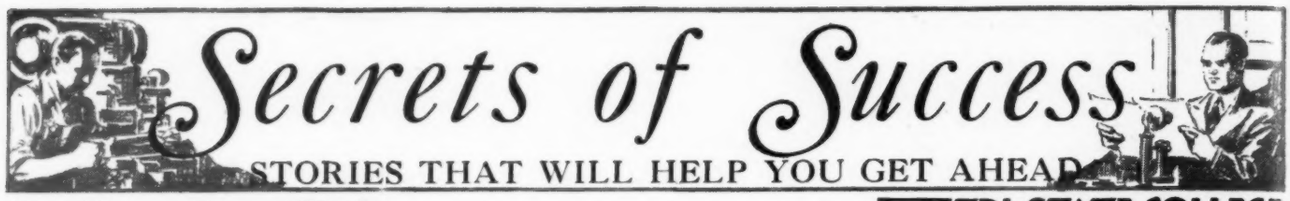

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Electrical Course in 2 Years

You can be enjoying a good Electrical job in 2 years—if you'll get ready for it. No man can land a job until he's fitted to do the work. Get ready now through home study in spare time.

Our instruction material specially prepared by 28 experts—noted Engineers from Westinghouse, General Electric, Commonwealth Edison, etc.—and well-known Educators. Complete employment service included. Send for Free Bulletin TODAY. No obligation.

American School, Dept. EC46, Drexel at 58th, Chicago

RESTRING YOUR RACKET

At Last! A practical, economical, easy method for TIGHTLY restringing tennis rackets at home.

UNIVERSAL FORGED HEAD BRACE, $1.45 Postpaid
This rugged head brace assures even tension, and taut strings. Prevents racket distortion while restringing.

SUPERIOR RESTRINGING OUTFIT, $1.65 Postpaid
Includes 37 ft. extra quality string. (Orange, Green, White; Red or Blue Spiral) Silk cord trim, tempered steel awls, and easy, illustrated instructions.

Money back guarantee. C.O.D. if desired. 10c extra. Send Check or Money Order.

The Tennis Equipment Co., Trenton, N. J.

"PET INSURANCE" IS GOOD MONEY MAKER

BLOODHOUNDS often are used to find and capture criminals; and St. Bernard dogs find and rescue lost travelers in the Alps. But a mongrel pet dog found his master a job with a living income, which gives promise of being permanent.

Jones' pet dog was lost. On the fourth day, after Jones had spent two dollars for ads and worried himself almost to illness, the finder of the dog telephoned to Jones and the pet was restored. Had the dog's collar carried his owner's address, said the finder, it would have been easy to return him the day he was found. Jones thought about that and inquiry among his friends showed that scarcely any dogs' collars carried the name and address of the owner. Further, said the dog lovers, they would be willing to spend a dollar to have a good, permanent identification placed on the dog's collars.

That was the beginning of a modest but profitable business for an unemployed man who had lost his dog. He figured the logical identification was an engraving on the plate affixed to most dog collars. So he visited his public library and borrowed all the books they had on engraving. Therein he learned the rudiments of the art, the graving tools required, and the easiest alphabet to use.

FOR a couple of dollars he bought three graving tools, and with them he practiced on a sheet of brass until he soon could print an easily read name and address, which would last as long as the collar to which it would be fastened. Although engraving is a fine art which requires years of study and practice in order to become expert, Jones found that a few days of diligent practice taught him to do rough, easily read engraving.

His next step was to sell his handiwork. He made a tag for his own dog's collar. Leading the dog as a sample, he then made a house-to-house canvass in a better residential section of his home city. The first day he received orders to make four nameplates for pets, which he engraved that afternoon and delivered the next day, for $1 each. That was all profit, because in each case he engraved the name on the plate already on the dog collar. Occasionally he is asked to furnish a plate. This he cuts from thin sheet brass, and affixes to the collar with brads. *(Continued on page 111)*

TRI-STATE COLLEGE

B.S. *Degree in 2 years*

B. S. Degree in Civil, Electrical, Mechanical, Chemical, Radio, Architectural and Aeronautical Engineering; Business Administration and Accounting. World famous for technical two year courses. Do four years' work in two. Non-essentials eliminated. Tuition and living costs low. For ambitious, earnest students. Those who lack high school training may make up work. Students from all parts of the world. Graduates successful. Located in picturesque hill and lake region. Enter September, January, March, June. 51st year. Write for chart, "Does A Degree in Engineering Pay?" Also *catalog*.

584 College Ave. Angola, Ind.

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GOOD JOBS Learn RADIO-TELEVISION

Electricity—Talking Pictures—in Los Angeles

A good job awaits you if you train immediately. Enroll with National. 30,000 graduates. Qualify as a radio repair man; television expert; sound expert; broadcaster; station technician; electrician and for many other jobs. Earn room and board while learning. We help you get job. For limited time we will allow coach railroad fare to Los Angeles. Send for free book which gives full details about different jobs you can qualify for, complete course of instruction and photographs of school operations. Sign and mail coupon.

NATIONAL RADIO & ELECTRICAL SCHOOL
Dept. PSR-8, 4006 So. Figueroa St., Los Angeles, Calif.
Please send me your big Free Book on Television, Talking Pictures, Radio and Electricity. Also details of R. R. fare offer.

Name .....

Address .....

City ..... State .....

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A broad, basic, intensive course

Complete in One School Year

AMBITIOUS young men prepared under skilled instructors for new opportunities in the electrical field. Approved by educators, endorsed by industry.

Bliss Men Make Good

41 years' successful experience assures you maximum training in minimum time. Catalog on request.

BLISS ELECTRICAL SCHOOL
108 Takoma Ave., Washington, D.C.

PRATT INSTITUTE

BROOKLYN, N. Y.
School of Science and Technology
ENGINEERING
Mechanical—Electrical—Chemical
INTENSIVE THREE-YEAR COURSES
Apply now for new year beginning September 11th
SEND FOR CATALOG "P"

MAKE MONEY At Home!

EARN steady income each week, working at home, coloring photos and miniatures in oil. Learn famous "Koehne Method" in few weeks. Work done by this method in big demand. No experience nor art talent needed. Many become independent this way. Send for free booklet, "Make Money at Home."

NATIONAL ART SCHOOL, Inc.
3601 Michigan Avenue, Dept. 136-C, Chicago, Illinois

Learn to MOUNT BIRDS

Be an expert Taxidermist. We teach you at home By Mail to mount **Birds, Animals, Game-Heads;** to tan skins. Mount wild game also common animals, squirrels, rabbits, frogs and pigeons. **Big Profits** in spare time.

FREE BOOK Tells all about Taxidermy—how to have a wonderful hobby and how to turn your spare time into **Sure Profits. Free.** Send **Today.** Don't delay. State Age.

N.W. SCHOOL OF TAXIDERMY, C-339 Court Bldg., Omaha, Neb.

FREE How To Secure A Government Position

Tells About These and Other Positions

RAILWAY POSTAL CLERK
$1850 to $2700 a year
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FREE BOOK tells how I can help you get a Government Job. For 8 years I was Civil Service Examiner—have helped thousands. If citizen 18 to 50, you may qualify. Get ready NOW for a Government position. Send for free book. Write or mail coupon TODAY.

A. R. PATTERSON, Civil Service Expert
168 Wisner Bldg., Rochester, N. Y.
Please send me your free book "How to Secure a Government Position."
Name .....
Address .....

NOW is the Time to Get Ready

for the BIG PAY JOBS IN AVIATION

LINCOLN-Trained

pilots and mechanics are in line for higher pay positions because they are qualified. Our Government-Licensed instructors know how to train you for the big pay jobs in aviation.

New Jobs

Government spending millions of dollars, promoting commercial aviation in a way that will mean thousands of new jobs. Now is the time for you to start training for one of these jobs.

Fly All Types of Planes—high and low wing monoplanes, biplanes, open cockpit and cabin transport ships. You learn straight flying, blind flying by instruments, cross country, spot landing, aerial navigation, acrobatics, including **Master Mechanics Course.** World's Best Known School. **Government Approved.**

Big Pay Opportunities in Central and South America as well as in U. S. Aviation taught in both English and Spanish. **Write** now! State your age.

LINCOLN AIRPLANE & FLYING SCHOOL
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EARN MONEY
STRINGING TENNIS RACKETS

Easy—Profitable—Interesting Work!

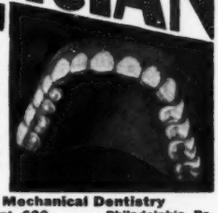
It's easy to earn $40.00 to $80.00 a month in spare time. Many TOMGUT Stringers who devote all their time to stringing, make $200.00 and more a month. **You can too!** We teach you how to string—show you how to get business—supply business-getting advertising helps. Our cooperative plan insures your success. **Start your own stringing business now!**

Send for Tennis Book

Send 3c for booklet "EARNING MONEY STRINGING TENNIS RACKETS" giving full details about this profitable business, including latest price list and folder of stringing equipment.

Thompson Manufacturing Co.
4529 Packers Ave., Chicago
Makers of famous **TOMGUT "Court Tested"** *Tennis Strings. Price range—enough strings for one racket, 80c and up.*

Be a DENTICIAN
LEARN AT HOME



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Build up your own business, or train for a better position and business leadership by learning to write persuasive Sales Letters, powerful Advertising, how to speak convincingly and interestingly, etc. Study at home in spare time. Low cost. Chance to earn while you learn. Write for free booklet.

BUSINESS LETTER INSTITUTE
324 So. Market St. Dept. 225 Chicago

Be an ARTIST

MAKE $50 TO $200 A WEEK!

Our simple, proven methods make it easy to learn Commercial Art, Cartooning and Designing quickly, AT HOME, in spare time. New low rate. Big new book, "ART for Pleasure and Profit", sent free. Address:

STUDIO 138, WASHINGTON SCHOOL OF ART
1115 15th ST. WASH., D. C. EST. 1914

Secrets of Success

"PET INSURANCE" IS GOOD MONEY MAKER

(Continued from page 110)

charging twenty-five cents extra.

Realizing he could not reach all or even a majority of dog owners by house-to-house canvassing, he extended his search for business by advertising in the newspapers, by placing samples in all the pet shops of his home city, and in the pet departments of large stores. He calls his business "Pet Insurance" and the average owner of a dog easily visualizes how much more quickly a lost dog will be returned if it carries identification.—E. L., Poughkeepsie, N. Y.

• • •

MAKES ADVERTISING PAY HIM BOTH WAYS

THE lot of the specialty salesman is not a particularly easy one, especially during times when business conditions are in a slump. So thought Guy Kennedy when he received notice that his firm was no longer paying expense accounts. He must live solely on his commissions, and lately they had been dwindling at an alarming rate. The trouble was not with himself, he figured, but with the product, which would soon have to relinquish its place to a more modern one.

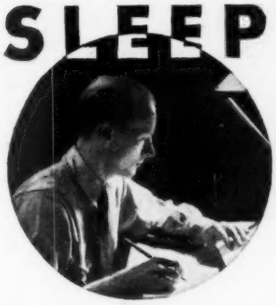
One evening while staying at a hotel in a distant city he happened to see a little advertising paper lying on the table before him. It was a small affair, carrying only the ads of the lesser concerns in the town. He immediately recognized it as a money maker for its owner, and began to size up the possibilities it would hold for himself.

Back home, Kennedy considered the venture thoroughly from all angles before deciding to undertake it. The town was ideal, having about 10,000 population, and boasting only one newspaper whose advertising rates were sky high. Naturally it followed that there must be scores of merchants who would like some advertising publicity but could not afford it in the local paper. A survey proved the correctness of this.

Then came the question of a printing press. Limited finances prevented buying one, but up on the second floor of an old business block he found two elderly, pleasant-faced gentlemen who were more than willing to print such a paper. They quoted him a flat rate per thousand, which figure would enable him to offer advertising rates at about half that of the local newspaper.

Guy Kennedy *(Continued on page 112)*

While Competitors SLEEP



SHORTER HOURS of actual labor may be the new order permanently. It is certain new trends have been inaugurated in our national scheme of living which will not soon pass.

This much is certain: *Success is, and will remain, a challenge to the individual. The man who wants to get ahead must really get ahead of other men.* And to get ahead of them he must have more training than they have.

All over the world, in hundreds of vocations, men are getting this training by study of International Correspondence Schools Courses. This institution, with its thorough and modern home study courses, has helped more men get ahead than any single educational agency in the world. Write for our interesting and free booklet, "The Business of Building Men." International Correspondence Schools, Scranton, Penna.

INTERNATIONAL CORRESPONDENCE SCHOOLS

"The Universal University" **Box 7698-G, Scranton, Penna.**

Without cost or obligation, please send me a copy of your booklet, **"Who Wins and Why,"** and full particulars about the subject *before* which I have marked X:

TECHNICAL AND INDUSTRIAL COURSES

☐ Architect
☐ Architectural Draftsman
☐ Building Estimating
☐ Wood Millworking
☐ Contractor and Builder
☐ Structural Draftsman
☐ Structural Engineer
☐ Electrical Engineer
☐ Electric Lighting
☐ Welding, Electric and Gas
☐ Telegraph Engineer
☐ Telephone Work
☐ Inventing and Patenting
☐ Mechanical Engineer
☐ Mechanical Draftsman
☐ Patternmaker ☐ Machinist
☐ Reading Shop Blueprints
☐ Heat Treatment of Metals
☐ Civil Engineer
☐ Highway Engineering
☐ Surveying and Mapping
☐ Gas Engines ☐ Toolmaker
☐ Diesel Engines
☐ Aviation Engines
☐ Bridge Engineer
☐ Automobile Work
☐ Plumbing ☐ Steam Fitting
☐ Heating ☐ Ventilation
☐ Air Conditioning
☐ Sanitary Engineer
☐ Sheet Metal Worker
☐ Steam Engineer
☐ Marine Engineer
☐ Refrigeration
☐ R. R. Locomotives
☐ R. R. Section Foreman
☐ R. R. Bridge and Building Foreman ☐ Air Brakes
☐ R. R. Signalman
☐ Pharmacy
☐ Chemistry
☐ Coal Mining Engineer
☐ Navigation ☐ Agriculture
☐ Textile Overseer or Supt.
☐ Cotton Manufacturing
☐ Woolen Manufacturing
☐ Fruit Growing ☐ Radio
☐ Poultry Farming

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☐ Secretarial Work
☐ Spanish ☐ French
☐ Salesmanship
☐ Wallpaper Decorating Salesmanship
☐ Service Station Salesmanship
☐ Advertising
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☐ Lettering Show Cards
☐ Stenography and Typing
☐ English ☐ Signs
☐ Civil Service
☐ Railway Mail Clerk
☐ Mail Carrier
☐ Grade School Subjects
☐ High School Subjects
☐ College Preparatory
☐ First Year College
☐ Illustrating ☐ Cartooning

Name ..... Age .....
Street Address .....
City ..... State .....
Occupation .....

If you reside in Canada, send this coupon to the International Correspondence Schools Canadian, Limited, Montreal, Canada.

BE A RADIO EXPERT

Many Make $40 $60 $75 a Week

Learn at home in spare time. Mail the coupon. Many men I trained make $40, $60, $75 a week. Many made $5, $10, $15 a week in spare time while learning. Get facts about Radio's quick growth, its future, and your opportunities in Radio. Home experimental outfits make learning easy, practical, fascinating. Money back agreement protects you. Mail coupon now for my FREE 64-page book "Rich Rewards in Radio."

J. E. Smith, President, Dept. 4HP3,
National Radio Institute, Washington, D. C.

Send me your free book, "Rich Rewards in Radio." This does not obligate me. (Please print plainly.)

Name ..... *Age* .....
Address .....
City ..... *State* .....

NOW YOU SHOULD PREPARE *for*
ELECTRICITY

I'll Finance Your Training!

Come to Coyne for 12 weeks—I'll give you a training by the Famous Coyne **"Learn by Doing"** method. Then I'll give you the help of my employment department in getting a real job. I will finance this training for you and you can pay your tuition **over a period of 15 months** after you graduate.

LEARN IN 12 WEEKS

My training is practical—you learn by working on **real actual electrical machinery** and **not** by books or lessons. We cut out all useless theory and give you **the training you need for success in 12 weeks.**

This New Age Demands Practical Trained Men

Get ready now for the great new prosperity. Thousands of trained men will be needed. **Thousands of opportunities today.** The new age demands more than ever—men with **specialized electrical training.** Get into **electricity** where you can learn to earn $35 a week and up. **Mail the coupon** today and I'll send you full particulars of my special offer—I'll send you **my big free book** which tells you how many **earn while learning**—my offer of Electric refrigeration course at no extra cost, and all details of my **pay after graduation plan.**

Learn by Doing

COYNE ELECTRICAL SCHOOL
H. C. LEWIS, *President*
500 S. Paulina St., Dept. C4-73, Chicago, Ill.

H. C. LEWIS, President, Coyne Electrical School
500 So. Paulina St., Dept. C4-73, Chicago

Send me full particulars of your special offer and **pay "Tuition after graduation plan."**

Name.....

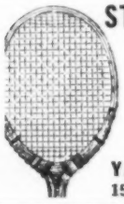
Address.....

City.....State.....

Electrical Refrigeration

Big new field — one of few that prospered during depression — offers well-paid jobs with a future to men trained in selling, installing, and servicing. Thousands of new units being sold and installed in homes, stores, offices, plants, etc. Home study will fit you for good job in 6 to 12 months. Employment service included. Send TODAY for Free Bulletin. No obligation.

American School, Dept. FC46, Drexel at 58th, Chicago



STRING TENNIS RACKETS

FINEST QUALITY SILK STRINGS

Complete stringing outfit 37 ft. coils—orange or green trim—awls, etc. $1.50 postpaid. Free Catalogue and Instructions.

Strings **75c** per set POSTPAID

(*Manufacturers & Importers*)

YANKEE TENNIS RACKET CO.
159 W. 125 St. NEW YORK CITY

"NEW DEAL" Government Jobs.

New Bandit Proof Railway Mail Car

Railway Postal Clerk

START $1900 a Year

Many Other Government Jobs
MEN—BOYS 18 to 50
Many examinations being held.

What you do with the coupon means more to you than to anyone else.

Mail it.

COUPON

Franklin Institute
Dept. E271, Rochester, N. Y.

Gentlemen: Rush to me without charge 32-page book with list of U. S. Government big paid positions. Advise me regarding the salaries, hours, duties, vacation and full particulars on how to get a job.

Name.....

Address.....

Secrets of Success

MAKES ADVERTISING PAY HIM BOTH WAYS

(Continued from page 111)

had had no actual experience in selling advertising, but he was possessed with the zeal and earnestness characteristic of one who enters a new field. And so, armed with a bundle of similar newspapers and a dummy of his own Shopper, (which was what he called it) he started out. His two strong selling points were low rates and guaranteed free delivery to every home in the town. He found that these were excellent inducements for the small merchant. At a few places, such as a barber shop, gas station and the like, he established worthwhile exchange accounts. By so doing he was able to procure necessities at no outlay of actual cash—just a few inches of space in the Shopper.

In short, the idea carried. Some of these merchants could be depended on each week; others alternated. True he had his problems, but with persistent effort and plenty of hard work they were always solved.

The distribution was simple. Each Friday afternoon some ten or twelve school boys called at the printing shop after the papers had been run off, and delivered them door to door in their allotted districts. Rigid supervision and consistency of delivery were the rules. In this way he made friends both with the advertisers and those who read the Shopper. People came to look forward to it every week just as they did their newspaper or favorite magazine. Guy Kennedy's Shopper was no longer an experiment; it was an institution—and a paying business.—W. K., Painesville, Ohio.

Cash Prizes

THIS department will give $5.00 for every true success story submitted by readers of Popular Science Monthly, and which is accepted for printing in this magazine.

Manuscripts will be judged on the individual merits of the case and circumstances involved. Only stories in which the author's success, or that of some one known to the author, has been gained by some method of educational guidance, fitness for the job, or application to the work will be considered. We are not looking for the "get-rich-quick" type of story.

Manuscripts must be confined to 500 words or less. They must be true and, if accepted, authors must be prepared to give us signed statements to the effect that they are true. Manuscripts submitted and printed become the property of this magazine, and we are not responsible for the return of rejected stories unless postage is provided for this purpose. Address contributions to Success Story Department, Popular Science Monthly, 381 4th Avenue, New York City.

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The best in education at reasonable expense at one of the nation's most distinguished military preparatory schools. Two complete school plants. Expertly planned program of spending Fall and Spring in the invigorating Blue Ridge Mountains—Winter on the seashore at Hollywood-by-the-Sea (between Miami and Palm Beach)—gives superior scholastic results. Every facility for education, sport and recreation. Correct academic placement and progress *guaranteed*. For catalogue address

Colonel Sandy Beaver, Pres., Box P, Gainesville, Georgia

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LEARN AT HOME

Are you adult, alert, ambitious, willing to study? Investigate LAW! We guide you step by step—furnish all texts, including 14-volume Law Library. Training prepared by leading law professors and given by members of bar. Degree of LL. B. conferred. Low cost, easy terms. Send NOW for Free, 64-page "Law Training for Leadership."

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and have a profitable vocation

There are many opportunities in this dignified and profitable profession. Learn quickly by the famous N. Y. I. method of instruction. Personal attendance or Home Study courses in Commercial, News, Portrait, or Motion Picture Photography. Free booklet, "*How to Succeed in Photography.*"

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Founded 1910
10 West 33 Street, Dept. 5, New York City

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STANDARD BUSINESS TRAINING INSTITUTE
Div. 308 Buffalo, N. Y.

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100% Improvement Guaranteed

We build, strengthen the vocal organs—*not with singing lessons*—but by fundamentally sound and scientifically correct *silent exercises* . . and absolutely *guarantee* to improve any singing or speaking voice *at least 100%*. . . . Write for wonderful voice book—sent free. Learn WHY you can now have the voice you want. No literature sent to anyone under 17 unless signed by parent.

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Without cost or obligation, please send me full details of your home-study course in

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Name.....

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You can complete our simplified High School Course at home in 2 years. Meets all requirements for college entrance, business, and the professions. Standard High School texts supplied. Diploma awarded. *Separate subjects if desired.*

20 Other Courses Over 200 noted Engineers, Business Men, and Educators helped prepare the special instruction which you need for the well-paid positions in —Business —Architecture —Automotive —Drafting —Electrical —Mechanical —Steam —Civil —Law. Check X *before* course that interests you, and mail TODAY for Free Bulletin. No obligation.

American School, Dept. HC46, Drexel at 58th, Chicago

SONGS WANTED FOR RADIO BROADCAST NEW WRITERS INVITED

Cash Payments Advanced Writers of Songs Used and publication secured. Send us any likely material (Words or Music) for consideration today. Radio Music Guild, 1650 Broadway, New York.

WANTED BRANCH MANUFACTURERS

On small or large scale for our NEW LINE of Cast Metal 5 and 10c Novelties, Automobiles, Ashtrays and other all year sellers. No special place or experience necessary as we furnish full instructions, with moulds and cooperate in selling, also buy finished goods. Chance of a lifetime for man with small capital to get into this new and profitable industry. If you mean strictly business and are over 21, write AT ONCE for details, as wholesale season is now starting.

METAL CAST PRODUCTS CO.
1696 Boston Road, Dept. E, New York, N. Y.

ENGINEERING and ARCHITECTURE

Intensive, Practical, Technical Courses, in Electrical, Mechanical, Structural, Architectural Engineering. Degree in 2 yrs. Diploma in 1 yr. Short courses in Electricity, Power Plant, Electric Refrigeration, Radio, Television, Drafting. Nonessentials eliminated. **Time and Money Saved.** Low tuition. Extensive modern equipment. Part-time work during training. 34 yrs. experience producing successful men. Write for catalog.

FINLAY ENGINEERING COLLEGE
1003 Indiana Ave. Kansas City, Mo.

CARTOON YOUR WAY TO SUCCESS!

DON'T COPY - LEARN TO ORIGINATE!

RAYE BURNS will teach you HOW to CREATE ORIGINAL CARTOONS at home that you can SELL! Course has 26 lessons and 600 illustrations. **$2.85**

Send name and address for free details. Only....

RAYE BURNS SCHOOL, Dept. S-X, Box 2194, Cleveland, Ohio

EARN $40 a MONTH at HOME!

"Yes, you can *easily* earn up to $1 an hour at home stringing tennis rackets! *No* experience needed. LEARN HOW TO EARN in a few minutes. I've already helped many fellows make $20 to $40 and MORE per month. Each job *pays* 200% PROFIT. *Think of it!* Go into *partnership* with Dad or a friend . . . your *home* is your *office!* Grab this great opportunity, plan now to make $100 to $200 cash *this season.* QUICK—write for FREE details!" **W. A. BICKEL, 809 W. Madison, Dept. C-136, CHICAGO, ILLINOIS.**

Set of Finest Silk Strings, illus. re-stringing guide, with easy directions All Prepaid **95c**

Make Money at Home

Grow our famous Fancy White Queen Mushrooms. Experience unnecessary—we tell you how. Big demand, at highest prices. Marketing facilities furnished. Illustrated book free. Write today!

AMERICAN MUSHROOM INDUSTRIES, LTD.
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EARN up to $25 A WEEK or More!

Learn Photography at HOME

Make money taking pictures. Prepare quickly during spare time. Also earn while you learn. No experience necessary. New easy method. Nothing else like it. Send at once for free book, *Opportunities in Modern Photography*, and full particulars.

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Be a representative of Popular Science Monthly. Taking subscriptions at the new low price is easy. And you can make good money at it. Write to **Popular Science Monthly, Circulation Manager, 381 4th Avenue, N. Y.**

BUILDING TUNNELS FOR BIGGEST WATER PIPE

(Continued from page 15)

miles; and the Cottonwood, which is four miles.

Records are smashed every month as working parties on the surface and below ground push forward.

One hundred and thirty miles of oiled-surface highways were completed recently in 180 consecutive days. These roads were built that workmen and heavy machinery might be transported across the desert to tunnel portals and to the thirty-one construction camps.

IN PREPARING to build the aqueduct, crews not only drilled twenty-two wells on the Colorado desert in eastern California, but chemists tested, treated, and softened the water before plumbers and pipe fitters laid 180 miles of pipe to construction camps and tunnels.

Aqueduct engineers constructed highways, surveyed the course many times during the last ten years, laid water pipe, and then built a power line so gigantic that three companies were forced to pool their resources to provide electricity—enough to light a city of a quarter-million inhabitants. This power reaches the aqueduct over a 450-mile line which wanders around mountains and over the desert from Colton, Calif.

So rapidly did skilled workers shove this line across the desert that they erected the last pole 300 days after starting, meanwhile having built a sub-station every ten days, a total of thirty.

When Boulder dam finally begins to produce its tremendous power, a little more than one-third will sparkle down the west side of the Colorado river, 155 miles to Parker dam, where the aqueduct will suck up one billion gallons daily to be pumped and siphoned 385 miles to thirteen southern California communities.

This energy will be used to turn massive pumps which, in five stages, will lift the water 1,357 feet during the first 130 miles. At the fifth point, known as Hayfield lift, it will be forced nearly straight up 440 feet.

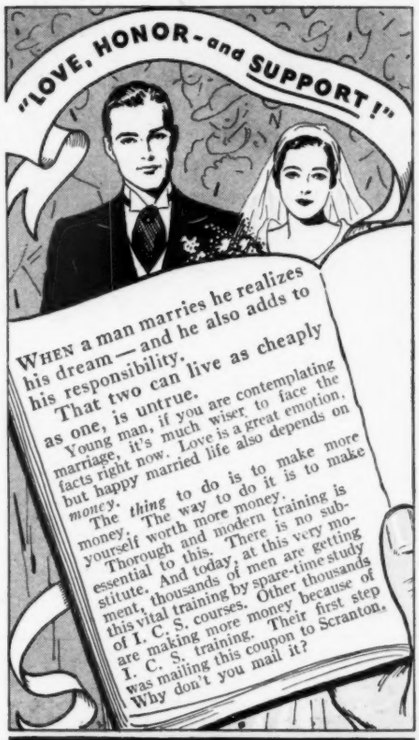
From Hayfield the water will flow through tunnels, siphons, and conduits 230 miles, all by gravity, into family bathtubs and factory boilers of Los Angeles and twelve neighboring cities.

One hundred and fifty double-barreled inverted siphons, having a total length of twenty-eight miles, are being built of concrete and steel. Each half measures twelve feet in diameter and will withstand an outward pressure of 240 pounds to the square inch. As this is written, engineers are experimenting with two types, monolithic and precast. Both types are round steel-lined concrete sections, but the monolithic is cast in place.

SIPHONS will be used not only actually to help siphon water over hills, but also to link tunnels together, even across flat land. Here the earth is scooped out and the siphons, largest ever fabricated, are buried in large ditches, thus taking the place of conduits which might be carried away by a cloudburst entailing an enormous loss and indefinitely interrupting the water service.

Siphons replace conduits and in one instance, the eighteen-mile East Coachella tunnel is being drilled lengthwise through a mountain to avoid building between shorter tunnels a series of connecting conduits, thus likewise avoiding the menace of sudden floods with consequent heavy loss.

The aqueduct wriggles like a snake in order that the several earthquake fault lines it traverses may be crossed in conduits and not through tunnels, thus avoiding a delay of months or years should a quake break the long line. It will be completed in five years, at a cost of $220,000,000.



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STRANGE THINGS PEOPLE COLLECT IN FOLLOWING THEIR HOBBIES

(Continued from page 43)

Joseph R. Kathrene has erected at West Milton, Ohio, a home for his collection—a library of a million items, newspaper clippings, advertisements, pictures, arranged alphabetically, on all manner of subjects. He has been collecting them for fifty years, and calculates that if pinned together into a pennant, and flown from the mooring mast atop the Empire State building, they would stream out for twenty miles.

IN TEXAS is a man who has made his collection into a house. Ross R. Wolfe gathered petrified wood and fossils from seventeen States and foreign countries. Of the run-of-the-mill specimens, he built a house, in whose main room he installed the prize specimens. With left overs, he built a fence around the house.

Ingenuity is the keynote of many collectors, who have ransacked their brains for something different. A recent St. Louis show had an exhibit labeled "Articles Found in Boys' Pockets on Wash Day." Consider the Los Angeles man who saves wishbones. Not just ordinary wishbones; they must come from fowl that have been eaten by celebrated men. Before Thanksgiving and Christmas, he sends out many letters, and gets a surprising number of responses. When the late Representative Oliver W. Mitchell, of Missouri, died, he willed to his heirs his collection of letters of the alphabet, excepting only "R," formed by twigs and branches, collected in many walking expeditions. On the same walks, a certain Englishman named Hanks would have collected spiderwebs, to be carefully preserved between two pieces of glass. A mechanic in Albany, N. Y., has managed to accumulate one each of 166 different kinds of cigarettes. Collectors of old and rare phonograph records have formed a club at Bridgeport, Conn.

What distinguished gentleman do you suppose collects toy soldiers? None other than H. G. Wells, advocate of universal peace. So do thousands of other grown-ups, of whom 800 exhibited at a recent Paris show. One Englishman has 10,000 soldiers. Like all the connoisseurs, he buys them unpainted, and colors them himself, with great attention to accuracy.

One man collects death warrants for Salem witches, and A. W. Towne of Syracuse, N. Y., amasses data on Siamese twins. In the same city, James Perkins treasures clippings and other information about centenarians. Others find fascination in gloating over accumulated doorknobs, metal-plated baby shoes, glass hats, comic valentines, rooster-shaped dishes, old pipe stoppers, toothpicks, milk-bottle tops and baggage labels. A New York broker, Mark Haas, has 28,000 matchboxes and labels, for which he paid from two cents to $500. Many save cigar bands, and one such once asked Calvin Coolidge for an addition to his collection. The President took a cigar from a full box, removed the band, handed it to the collector, and carefully replaced the cigar in the box—which he closed, firmly.

JOEL V. BARBER, of New York, saves decoy ducks. He exhibited them at a recent show at a department store. Earl Smith, of Pasadena, Calif., has 2,000 different cartridges. They were exhibited recently beside 300 varieties of snakes, collected by an amateur. Lord Walter Rothschild, of the great banking house, collected albino animals and birds. He had fifty specimens, including a white robin and a white woodchuck. At a recent Chicago show, some one exhibited 750 types of golf tees.

Recently collectors have become busy saving beer and whisky labels. Repeal has given a great fillip to collecting bottles, of which a leading exemplar is Joseh C. Auchincoss, president of the National Better Business Bureau. One man in Elizabeth City, N. C., will have only whisky bottles that have been thrown overboard from ships. Many value bottles, especially flasks, that have been long exposed to the sun and turned a beautiful violet shade. A former cowpuncher, in ill health from war service, made a living searching California deserts and old deserted camps for such bottles, selling them for $5 or $10.

ALL sorts of glass attract collectors, and some connoisseurs specialize on glass from windows of churches, monasteries, or other old buildings. One bit, scarcely two inches square, brought nearly $100,000 and a diamond-shaped pane with three figures, $25,000. The most valuable glass was made before 1550, but is very fragile. World War destruction rather glutted the market for glass fragments, and incidentally, made possible another collection recently exhibited: home-made portraits and tapestries of saints and other sacred figures, given, often by peasants, to churches throughout Central Europe and recovered from their ruins.

Minerals have enthused Thomas A. Smith, of California, since he began collecting them four years ago at the age of seventy-six. All his life, Smith was a citrus grower. Now he has just finished making an amazing stone table. The top, 18½ by 28 inches is inlaid with cut and polished stones, no two alike. The center is of South African tiger-eye, bloodstone from Death Valley, mottled Arizona jasper, Mexican malachite, and Arabian azurite. The rest of the top is made of 315 pieces from other sections of the world, done crazy-quilt style.

For years, Mrs. Gustine Courson Weaver, of Texas, has been traveling about the world with her husband. Wherever she went, she picked up interesting dolls, in costume. Friends, even strangers, sent her more. Today Mrs. Weaver has 400 in the costumes of fifty countries.

Maurice Blumenthal's collection of 1,000 pairs of cuff buttons, is the pride of Brooklyn, N. Y. Blumenthal also saves ash trays, watch chains, earrings—all of stone, not metal. This is his relaxation from large-scale excavating, such as digging subways. Once, beneath the Vanderbilt Hotel, New York, he struck gold.

Pictures of fairies are collected by Dr. Thaddeus P. Hyatt, chief dentist of the Metropolitan Life Insurance office in New York. He has 200 of them.

ONE of the most remarkable and costly jewelry collections is the 1,000 clocks and watches of Major Paul M. Chamberlain of Newark, N. J. Towering above the rest in interest and antiquity, is a clock dated 1573. It is of wrought iron, made on the anvil, and has only an hour hand, for minute hands did not come in until 1700, and is driven by weights with a fall of six feet for twelve hours. A remarkable Japanese clock, about 1760, has a hand that stands still while the dial revolves, marking day and night in six periods each. Four times a year the clock is adjusted to the length of the day, and strikes nine, eight, seven, six, five and four bells, but not three, two, and one, for those are sacred temple-bell strokes. There are watches that tell sun time as well as mean time, musical watches that play tunes, watches in sea shells and walnuts, and an electric watch run by a battery carried in the pocket, made in Geneva about 1880. The same man made a watch containing *(Continued on page 115)*

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STRANGE THINGS PEOPLE COLLECT

(Continued from page 114)

a phonograph that calls the hours in French. Incidentally, the first wrist watch was worn by Queen Elizabeth, and tragic Mary, Queen of Scots, had a watch shaped like a skull with various emblems of death. It still runs, and tolls the hours.

PERHAPS equally morbid is the collection of M. A. Gill, of Kansas City, Mo. He has nearly a hundred pairs of handcuffs, each of which has been worn by a genuine murderer. They go back to 1620, but the most gruesome pair is quite new, and was itself a murder's weapon, for with those handcuffs a negro prisoner beat an Oklahoma sheriff to death. Warden Anderson, of Leavenworth prison, has a large collection of safe-cracking tools, crooked gambling wheels, and other criminal devices, the gift of some of his former guests.

It was like meeting boyhood friends, to gaze once more upon the colorful covers of Nick Carter, Secret Service, Pluck and Luck and the rest displayed at a New York show by Charles Bragin, of Brooklyn, who has 30,000 paper-backed novels that once held boys enthralled. This collection is valued at $25,000.

Today's commonplaces are tomorrow's antiques. Like the Currier and Ives lithographs that sell for fifty cents to $3,000, the last for the sanguinary fight with a bear in "The Life of a Hunter, or A Tight Fix." There are only six copies—unless you have the seventh in that old trunk in the attic.

Among the aristocrats of Americana, are the ancient tribe of cigar Indians. Those shiny wooden Aborigines extending bundles of rich Havanas, that used to ornament the fronts of tobacco stores, are vanishing like the Indians themselves. In Indiana, Missouri, and Alabama are some of the last of these Mohicans. But collectors are getting their scalps at enormous prices. Henry Ford has paid $1,500 to $2,000 apiece. Norman Gehri, of Morristown, N. J., who collects these figures, has two unique specimens: a beautiful circus performer in blue tights, holding a gas cigar lighter, and a gigantic Punchinello in bright red and blue.

HOW they love their collections, and what a good time they have over them! Here are a few advertisements from a collectors' magazine:

"Petrified rye, nature's curiosity, to trade. I want tubular shell wampum, old handmade iron nails, showy butterflies mounted and correctly labeled. For extra fine specimens will give beautiful Lithuanian amber with insect imbedded."

"Cleveland car tokens, Ohio auto plates, covers, permits, postmarks, Indian head pennies for mint U. S. stamps."

"Will trade fine fossil fishes for fine grooved axes, mound pottery, or long spears."

"Circus parade photographs—gloss finish, non-fading, five by seven, five views of beautiful horse-drawn street displays. Will swap for ancient newspapers containing circus advertisements or stories."

"Wanted—Sixteen millimeter films taken before 1905. Also historical, famous-men films of antique things of all kinds, odd happenings."

"Valentines and valentine covers, before 1870. Also illustrated envelopes and odd cancellations."

"Wanted—Old railroad tickets, time-tables, train-checks."

Collecting is growing, following President Roosevelt's example. The very latest is collecting Rooseveltiana. One man in Chicago has collected nearly a thousand pictures of the President—and is still at it.

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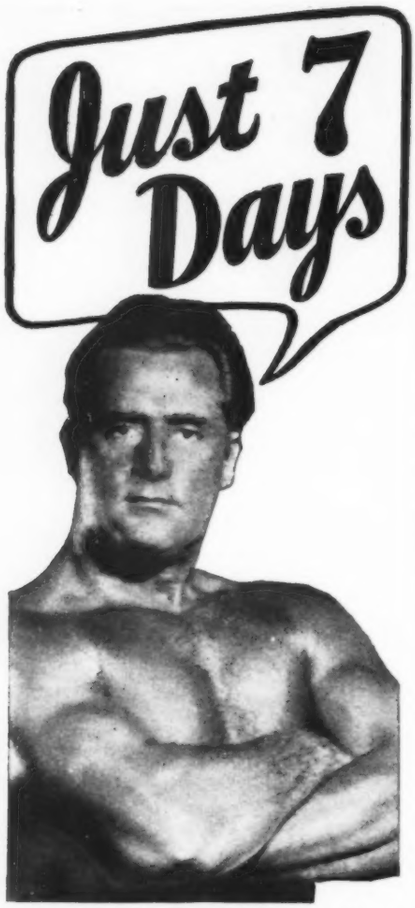

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ARE YOUR HEADLIGHTS SAFE? ASKS GUS

(Continued from page 68)

flectors. They're so dirty it's just luck that you get any light. Why don't you clean them now and then?"

"Thought you weren't supposed to touch them," replied the man.

"You're not supposed to touch them with your fingers," agreed Gus. "But that doesn't stop you from using a piece of cotton or a soft cloth. A trick that I find works well is to dip an old handkerchief in alcohol and then in lamp black. The combination makes a swell cleaner and polish. Don't rub the reflectors too hard, just enough to bring back some of the original silver finish. Of course, if they're too far gone, you can have them resilvered in almost any large city.

"And while we're on the subject," added Gus holding up one of the lens holders, "polishing won't do much good unless you renew these lens gaskets in the rims. They're pretty badly rotted and aren't much help in keeping out the dirt and moisture."

"How about focusing the lights? Would that do any good?"

"Not these headlights. They're focused already—prefocused they call them. All the newer cars have them. The only adjustment they'll ever need is a little aiming.

"YOU can test that by drawing a chalk line on the back wall of your garage, making it parallel to the floor and on a level with the centers of your headlights. Then, back your car out on the driveway so that the headlights are about twenty-five feet from the wall and turn on your driving lights. The upper edge of the bright beam shouldn't go much above the line. If it does, shield first one light and then the other to find out which one is out of whack and then re-aim it by adjusting the aiming screw or clamp under the headlight.

"If you will paint some sort of guide line on your driveway to tell you when your headlights are just about twenty-five feet from the wall, you can test your lights every time you drive into the garage. Just stop a minute at that spot, turn on your driving lights, and watch where the beam comes."

"I wouldn't mind night driving at all," remarked the car owner, "if it wasn't for the terrific glare you get from about nine tenths of the cars on the road. My headlights don't seem to push past the other lights at all. It's just like driving blind."

"They're going to try out a tricky way of eliminating glare on the roads in Germany," replied Gus. "In the centers of the high speed roads, they're planting a long series of hedges crossways to make a lane. Being short and planted across the road like the leaves of a shutter, they won't cut off the view but will cut off the glare.

"SPEAKING of glare," continued Gus as he fastened the lenses back into place, "reminds me of old man Curtis. About a year ago, Mr. Curtis had to make a lot of long trips in his car. On each trip, he took a small bottle of water and a soft cloth. Every night, as soon as it got dark, he'd stop his car, wet the cloth with the water, and wash off the headlight lenses."

"Is there anything that the average driver can do to improve his lighting equipment?" the man asked when Gus had finished.

"Well, besides perhaps adding a spotlight to light up the edge of the road and a couple of fender lights, I'd say that a pilot light mounted on the instrument board and wired into the tail-light circuit would be the most helpful. The tail lamp is one important light the car owner can't see. A pilot, wired in series with the tail light, will let him know the minute the tail-light bulb fails."

NEW METHODS SMASH AUTO STEALING RACKET

(Continued from page 13)

case, a Los Angeles woman's car had been stolen. Months later, a car which seemed familiar caught her attention as she crossed the street. She followed it to an auto laundry, where its driver left it to be washed.

Closely inspecting the car, the woman recognized tell-tale marks where the finish had once been accidentally marred. She telephoned the insurance company which had paid her claim. Messages flashed over the wires. From Sacramento, 400 miles away, all information on the stolen car was teletyped to Los Angeles. An investigator from the National Automobile Theft Bureau raced to the scene, accompanied by two police officers. When the driver returned, he was trailed by police, to a nearby suburb, where he met two other men. Police captured all three, and found them to be professional thieves whose arrest cleared up a number of unsolved crimes.

IN ANOTHER case, the police in half a a dozen cities were kept busy for months tracing a tangle of thefts by a large ring of automobile thieves whose operations covered five states. The case came to a head when the Los Angeles office of the National Auto Theft Bureau received a flash from Oklahoma City that several men suspected of belonging to a hot-car ring were heading toward Los Angeles with a stolen car. For some reason, the crooks did not appear.

Then Superintendent W. E. Schoppe of the San Francisco bureau, received a long-distance call from officers in Reno. Four men had visited a printer's shop, leaving an Oklahoma registration certificate with orders to print 150 copies. The printer promised to have them ready in the afternoon but reported their license number to police.

Four hours later, Special Agent Jimmie Britt was speeding by air transport to Reno with complete information to aid U. S. Department of Justice agents in prosecuting the case under the Dyer act, which forbids transporting stolen cars from state to state. Returning for the forged certificate, which they expected to use in their wholesale thefts, the thieves walked into the arms of police officers. Through the roundup of this gang a large number of automobiles were recovered. The gang had specialized in one type of car, stealing them in Oklahoma City and selling them in California.

Before it was broken up, not long ago, one New York auto-stealing mob worked the ruse of whisking hot cars into a special garage, destroying the motors and then substituting others taken from wrecked machines purchased for a song by members of the gang. By buying wrecked cars, in this way, they obtained legal title to machines with the engine numbers which would be found in the stolen automobiles. However, secret identification numbers on the bodies and chassis of the cars led to the detection of the men and the recovery of forty cars stolen in thirty days.

Since the parts of similar cars can be interchanged easily, racketeers frequently specialize in one make and model of machine. A few months ago, deputy sheriffs, connected with the Los Angeles sheriff's office, smashed a gang and recovered 142 cars of the same model.

TO WELD police forces into a single unit that will eliminate state lines in the war against automobile stealing, a new organization is being formed, uniting all state police and sheriff's departments west of the Mississippi. Instant exchange of information, cooperation of the courts in eliminating legal technicalities, and the use of scientific methods of detection, will make this fighting unit a powerful instrument in stamping out the hot-car organizations of the gang world.

INDUSTRIAL MYSTERIES SOLVED BY LABORATORY MAGICIANS

(Continued from page 21)

repeated the experiment. The fluid turned yellow. Unable to solve the enigma, the manufacturer turned to Foster D. Snell, an industrial chemist.

In his researches, Snell followed a curious chain of clues. He found that when sunlight struck the liquid in the bottles, a chemical reaction produced acid vapors. These vapors did not change the fluid's color. But they did attack the lining of the bottle cap. The decomposition of this lining, in turn, produced a chemical substance which dissolved in the liquid and changed its color!

IN A similar case, solved by the same chemist-detective, a pink polish sold in tin cans remained pink for a year. Then it turned yellow. No air or light reached it, but a slow reaction, Snell discovered, between one chemical element in the polish and the tin of the can was responsible for the alteration in its hue.

Another problem of color change was not so simple. Some years ago, white linen shoes became the fashion for summer wear. Manufacturers turned them out by the thousand to meet the sudden demand. They were formed, as dark cloth shoes had been before, by a "rubber sandwich"—linen on the outside, duck on the inside, and a layer of rubber between.

Hardly had the shoes been placed in store windows before complaints were heard. The white linen was changing to a jaundiced yellow. The manufacturers had used the same methods for years with dark shoes and there had been no trouble. They examined the cloth, the rubber, the thread used in the factory. No clues. Then an industrial chemist put his finger on the curious source of the trouble.

Sunlight, penetrating the white cloth, was decomposing the unvulcanized rubber. This decomposition produced substances which permeated the linen and changed its color. The same thing had happened in the darker shoes but the shift in hue had not been at all noticeable.

In the realm of industrial chemistry, rubber is a frequent producer of riddles which only the trained laboratory detective can solve. One of the most puzzling of these was the mystery of the rigid raincoats.

A MIDWESTERN manufacturer had turned out a new type of raincoat which passed laboratory tests in brilliant fashion. He placed the garment on the market with high expectations. A few weeks later, he got a jolt in the form of a dozen letters. The brown coats had started to harden up in stores, had become brittle and, finally, so rigid that, like Charles Goodyear's famous rubber coat, they would stand up by themselves!

Stumped by the problem, he stopped production and sought the aid of Dr. Irving Hochstadter, New York industrial chemist. This expert traced the trouble to the brown dye used to color the fabric. It contained minute traces of copper. This metal was acting as a catalyst, hastening the oxidation of the under layers of rubber. By a simple change in dye, the manufacturer overcame the trouble and was able to continue producing the coats.

Sometimes, the investigations of a laboratory trouble shooter take a surprising turn, a pleasant surprise.

In developing a mountain tract for homes in the west, for instance, real estate operators recently found a spring of delicious water. It had sparkle and snap and a pleasing taste. But shortly after the tract was opened, several cases of dysentery appeared. Prof. Maas was called from Los Angeles to investigate.

He quickly found the trouble. Surface water, seeping into the spring, had filled it with harmful bacteria. Walling in the well remedied this. But, bacteria were not the only things found by the analysis. Maas found the spring was located in an ancient volcanic crater and was fed by underground channels running through feldspar. This rock imparted to the fluid chemicals that turned it into something comparatively rare, natural soda water. Since soda is helpful in digestive disorders, the researches of the chemist had suddenly turned the spring from a liability into a valuable asset that made him wealthy.

In Alabama, another industrial chemist tackled a problem and found in its solution a fortune that has mounted into millions. He was Theodore Swann, a young man who was making phosphorus by means of an electric furnace. Soon after he began operations, a mysterious blight spread over the fields of neighboring farms. Cotton, corn, and potatoes died. Irate farmers blamed the fumes coming from the smokestack of his little plant. Chemical tests showed Swann that phosphorus fumes were causing the trouble. The problem was to rid the smoke of these noxious vapors.

HE TRIED a dozen schemes before he hit upon one that distilled the phosphorus from the smoke in the chimney and overcame the trouble. Then he found that, from the waste gases, his still was making phosphoric acid, a product useful in a hundred ways. It is employed, for instance, in making wheat flour self-rising. The acid flowing from the spigot of his still was pure and cheap. Soon he had cornered the entire phosphoric acid trade of the milling industry and out of his solution of the chemical mystery, he has built a fortune.

Reading the Bible led another industrial chemist to tackle a problem which, when he had unearthed the solution, brought him a fortune and gave industry a new lubricant of great value.

He was the late Edward G. Acheson, famous American chemist, once associated with Thomas A. Edison. The Biblical passage telling of the difficulties of the Children of Israel in making bricks without straw set him wondering. Why was straw necessary? What was the element in it that was needed?

Analyzing samples of straw, he found it was the chemical, tannin. He applied this information to lubricants and discovered that by adding tannin to oils he could make graphite remain in colloidal suspension. Without the tannin, the graphite formed granules instead of being evenly dispersed throughout the oil. This find opened a whole new field in the realm of lubrication.

OFTEN, the laboratory expert can overcome mysterious problems of industry by simple shifts in manufacturing procedure that cost practically nothing. For instance, when a manufacturer noted variations in the texture of his cold cream, a chemist discovered it was caused by the practice of stirring the cream first one way and then the other. When the stirring continued in the same direction from beginning to end, the difficulty disappeared.

A change of less than one percent in the ingredients that make up a product will often result in eliminating mysterious troubles. In one case, a polishing fluid produced a high gloss that soon disappeared. A consulting chemist's experiments disclosed that the addition of one tenth of one percent of one of the ingredients made the gloss more permanent.

In another *(Continued on page 118)*

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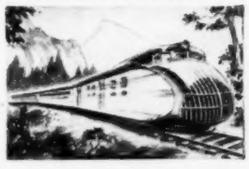

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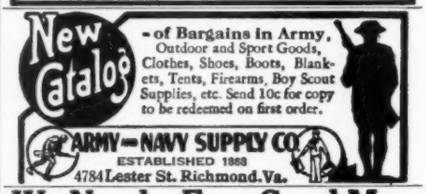
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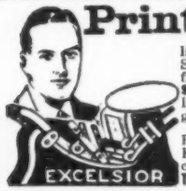

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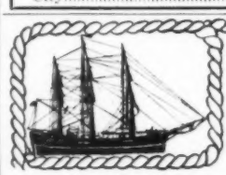

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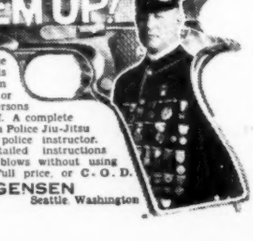

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MYSTERIES SOLVED BY LABORATORY MAGICIANS

(Continued from page 117)

instance, a good waterproofing material had an offensive odor. When an expert analyzed the product he found that a chemical which comprised only six tenths of one percent of the mixture was responsible for the odor. In addition, he discovered that the chemical was not needed at all in the preparation.

ONLY the aid of a high-powered microscope enabled one chemist-detective to solve a recent mystery in connection with a scouring preparation. Diatomaceous earth, that is, earth formed by certain dried microscopic plants, was used as the scouring medium in the liquid. When the manufacturers began buying the earth from another source, they ran into difficulties. The material they had used before would remain in suspension in the liquid; the new material settled to the bottom. To the unaided eye both earths looked the same. The chemist, to whom they took their problem, peered at samples through a microscope. The lens showed that the diatoms in the old material were roundish; those in the new material of other shapes. The solution of the mystery was that one of the earths was made up of salt-water, and the other of fresh-water, diatoms.

Everyone knows that if you put a drop of sulphuric acid on a piece of metal, the acid will eat its way into it. Yet thousands of gallons of sulphuric acid are shipped in ordinary metal tank cars. Why doesn't the powerful fluid eat its way through the sides? A green scum of ferrous sulphide, formed by the reaction of the acid and the steel tank, is the answer.

Last summer, however, in tank cars carrying sulphuric acid to a plant at Whiting, Ind., the acid suddenly began eating its way into the metal. Chemists examined the cars and found the protective coating had practically disappeared. What had caused the change—something in the metal or something in the acid? No one could offer a satisfactory explanation. Then from an unexpected source, came the solution of the mystery.

A young employe, determined to make good at his job, had peeked in the cars, seen the ugly green scum and had conscientiously cleaned it out when the tanks were empty!

ANOTHER employe was responsible for a mystery that ended in a curious climax, a few years ago. Chemists in an eastern dye plant were working on a new coloring compound. The best they could obtain from a certain combination of chemicals was one percent dye. Leaving an office boy stirring the mixture over a Bunsen burner, one noon, they went out for lunch. On returning, they examined the fluid and let out whoops of joy. The beaker contained ninety percent dye!

Hurriedly they mixed a fresh batch of chemicals, heated it and got—one percent dye. They questioned the office boy. He was positive he had done nothing but stir the liquid as he had been told. Again and again, the chemists repeated their test. Always they got the same discouraging result. Finally, the office boy broke down and confessed. While they were out to lunch, he said, he had violated a strict company rule. He had smoked a cigarette and some of the ashes had dropped into the beaker. Frightened, he had stirred them in and said nothing about it.

Rushing to the laboratory, the men mixed chemicals, lit cigarettes and flicked ashes into beakers. The result: ninety percent dye! A certain oxide in the cigarette ash later proved to be the miracle-working chemical.

Thus in an infinite variety of ways, the solution of chemical mysteries and the work of detectives of the test tube play their dramatic parts in the world of industry.

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Freak Hazards Met by Telephone Trouble Men

(Continued from page 35)

repairman found the baby had been cutting its teeth on a telephone cord and the moisture had reached the wire.

When he goes to a private house, the trouble shooter is ready for anything. One found a pet parrot pecking away at a wire. Another time, a phone was reported as unusually noisy. Investigation showed that a monkey, which lived in a cellar, was in the habit of getting exercise by swinging on the wires.

ROY HANDLEY, a trouble man in Seattle, Wash., tells of an even stranger discovery. A woman called up and said her bell wouldn't ring but when anyone was trying to get her on the phone her dog always howled in the back yard. Handley investigated. The dog, he found, was chained to the lead-in wires and every time the number was called a short circuit gave him a shock.

Dynamite caused telephone grief, not long ago, under curious circumstances near St. Louis, Mo. An old man, looking for buried treasure, began blasting in a field and the flying rocks broke wires on a main telephone line nearby.

Along the Columbia River, in Oregon, flying rocks proved a constant problem for trouble shooters. Time after time, rock blasted from a nearby quarry sheared off long-distance lines. Finally a wire netting, an eighth of a mile long and twenty-four feet wide, had to be erected over the wires to protect the lines and prevent interruption of the service.

In this same part of the country, a log jam in the Skagit River gave one lineman the scare of his life. Near Sedro Woolley, Wash., the jam had piled up until a projecting timber hooked a sagging telephone cable, pulling it as taut as a violin string. The poles on either bank were bowed half way to the ground. To relieve the tension, one of the linemen, Amos Hosler, climbed the pole on the south bank. Just as he reached the top, the cable snapped. The released pole whipped up, hurling Hosler fifty feet into the air. He crashed into the thick branches of a giant fir tree and after regaining his breath climbed to the ground with only a few scratches and no broken bones.

On a number of occasions, poles have snapped off while workmen were at the top. They have ridden them like Cossacks to the ground, leaping to one side just before they struck. In fact, figures recently compiled by the National Safety Council indicate that a lineman working at the top of a pole is just as good a risk as a man watching him from the sidewalk.

It is when he least expects it that he runs into danger, as Harold Sherwood, a trouble hunter on Long Island, N. Y., discovered. When he opened the door of a connection box at the top of a pole on Main Street in Patchogue, out poured a swarm of bees. In fighting off the insects, he nearly fell to the pavement. However, the adventure had its bright side, for, after he had gassed the bees with a chemical fire extinguisher, he found ten pounds of honey in the box.

IT WAS a search for honey that balled up telephone service in the Adirondacks. A bear, shambling along a deserted road, heard the buzzing of telephone wires and climbed a pole to investigate. He found no bees and no scent of honey but he noted that the humming apparently came from the glass insulators. So he cuffed them back and forth until service was disrupted on the line. Then he climbed down, leaving a trail of claw-marks to tell the story.

Even stranger was the cause of broken service near Gulfport, Miss. A waterspout swept in from the Gulf of Mexico, broke against the sea wall, and continued inland as a twister. Uprooting trees, it lifted a house completely into the air and dropped it on a telephone line.

A bit of quick thinking in Texas saved a dozen wires during a flood. High water, overflowing the banks of a river, threatened to sweep a pole and its attached wires down stream. It was impossible to get to the pole. So one of the linemen got a rifle and shot the insulators off the cross arm. As the pole crashed, the wires swung free above the water.

The world's highest wires are in South America. They form the recently completed cable that crosses the Andes from Chile to Argentina. Near Las Cuevas, on the Argentine side, they are 12,300 feet above the sea.

Hauled by trains, by trucks, and finally on the backs of workers, the cables were laid in trenches blasted from the solid rock far above the timberline. By burying the cable in rock all the way from Las Cuevas to Juncal, on the Chilean side, engineers have overcome the constant menace of avalanches and snowstorms, thus simplifying the work of the Andean trouble men.

Probably the one thing that brings the greatest amount of grief to the door of linemen is sleet. The great New England ice storm of 1921, which lasted three days and affected 3,600 square miles, wrecked telephone, telegraph, and electric light lines valued at $5,000,000. More than a million miles of wire had to be strung from stumps and trees to provide temporary service. As much as four tons of ice accumulated on the wires between two poles. When a falling tree caused a break in the line, the tension would make the poles for miles snap off like pipestems, one after another in rapid succession.

However, the use of cables that hold the wires in a compact casing has gone far to eliminate the ice menace. In New York City, for example, there are 8,000,000 miles of wire, all carried from building to building by underground cables. One unusual result of this underground concentration of telephone wires appeared not long ago. A subway fire interrupted the flow of current through the cables and as a result 2,000 burglar alarms sounded at the same time.

At present, cables carry long-distance telephone messages as far west as Omaha, Neb. One line alone is spending upwards of $100,000,000 a year for new cables. However, increasing use of these bundles of wires within their lead shells has brought new problems. One is the short-circuit beetle. It is an insect that by boring holes in the cables, permits moisture to enter and ruin the insulation. So troublesome did these beetles become in California that experts from the U. S. Department of Agriculture made special investigations and published a short-circuit beetle bulletin as a result of their tests.

The scientists built cages around the cables and, putting the beetles inside, noted where and how they bored their holes. Then they constructed boxes lined with various lead alloys in an effort to find a substance the insects would avoid. The boring bugs penetrated all with equal ease. Finally, they impregnated lead with a dozen poisons. These had no effect upon the insects. The only suggestion the government men could offer was to change the type of suspension ring used in holding up the cable. They found the beetles almost invariably bored their holes alongside these supporting rings, penetrating upward from the bottom and thus reaching the cable.

Squirrels, birds, and air rifles also account for troublesome holes in telephone cables. The squirrels sharpen their teeth on the lead, biting out chunks that let the moisture in, while in Bermuda, a parrotlike bird nibbles the metal as a choice dessert. Near Baltimore, Md., forty feet of expensive cable was ruined by a tiny hole made by a shot from an air rifle. Rain, entering the hole, ran down the sagging line spoiling the insulation.

Near Harlingen, Texas, a hurricane drove a three-foot board through the center of a cable. It instantly cut off all service for more than 1,200 phones.

Recently an inventor has provided a robot alarm for leaks. He has designed a gas-filled cable which is being widely adopted. The space around the wires is filled with nitrogen gas at a pressure of twelve pounds per square inch. Any opening or break in the lead coating lets the gas escape and sounds an immediate alarm.

Another mechanism enables the telephone expert to locate the exact point at which a break in a wire has occurred. It is an adaptation of the Wheatstone Bridge, an electrical seesaw on which the resistance of the wire to the break is balanced by the variable resistance of coils. Knowing the resistance per foot or per mile of the wire, it is easy to compute the distance to the break by dividing this figure into the total resistance of the broken strand.

Such scientific helps aid the trouble shooter in his strange, endless battle against the unexpected. By employing new equipment and by eternal vigilance, he is overcoming a curious array of foes, keeping intact a far-flung network of wires and making possible the modern telephone.

Torpedoes Launched from Station on Land

Practicing with their deadly naval weapon, Italian sailors discharge torpedoes from a land tube at a fixed target in the Gulf of Spezia. In this way they get the necessary training without once going to sea

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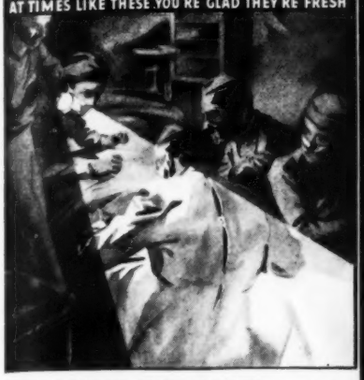

CITY POWER HAD FAILED . . . during a mastoiditis operation. Then . . . *light*, blessed light . . . from the flashlight of Nurse Bell.* Instantly Dr. Scott* was at work again . . . A life had been saved.

*Not their real names, although real names were given in the newspaper report.

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